The Effects of Music Therapy on Dental Anxiety

Thesis

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By

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Abstract

Dental procedures can cause significant anxiety for individuals with dental anxiety. Music therapy has been shown to decrease anxiety levels when the individuals have listened to music prior to the dental procedure. Few studies have examined the effects of music therapy on dental anxiety when the individual listened to the music during the procedure. There is also limited research available about the effects of different music types on dental anxiety. Knowing whether music and the kind of music have an anxiety-reducing effect on dental anxiety would be beneficial for clinicians and patients suffering from dental anxiety. In this experimental study, a pre-test and post-test design was utilized. 30 patients (mean age, 41 years) were assigned to one of three groups by computer randomization. Group 1 sat quietly during their dental appointment without listening to any music. Group 2 listened to classical music, and group 3 listened to their choice of music. Blood pressure, respiration rate, heart rate, and a Modified Dental Anxiety Scale score was measured before and after the dental procedure for all three groups. There were no significant differences between pre-procedure and post-procedure measurements. There were no significant differences between the three groups. Listening to music did not have a significant effect on dental anxiety in this study. Future research should focus on utilizing a larger sample size to study the effects of music on dental anxiety during a procedure.

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Chapter 1. Introduction

Many individuals experience dental anxiety, dental fear, and dental phobia. Dental anxiety is defined as a general state of apprehension in which an individual is fearful that something bad is going to happen (1). Dental anxiety is a fear of something that is poorly defined, is dental related, and is interpreted as dangerous or harmful (2). Dental fear is different than dental anxiety. Dental fear occurs when an individual has a normal emotional response to something they feel is threatening in the dental environment (1). Dental phobia is a severe form of dental anxiety. Dental phobia can result in avoiding the dentist and dental treatment. If an individual with dental phobia presents for dental treatment they may be extremely anxious and feel significant discomfort (1).

Individuals with dental anxiety may experience apprehension, a feeling of dread or danger, tension, and restlessness. Dyspnea and tachycardia may be experienced by an individual with dental anxiety (3). Individuals with dental anxiety have also reported experiencing negative feelings and thoughts, sleep disturbances, increased use of medications, and decreased occupational and social functioning when compared to patients without dental anxiety (4). Dental anxiety affects 10-20% of the adults in the United States (5,6). Individuals are effected by dental anxiety for a number of reasons and it can manifest itself in different ways in different individuals (7).

Individuals with dental anxiety can be classified into two groups- exogenous and endogenous. In individuals with endogenous dental anxiety the individuals have an internal predisposition to generalized anxiety disorders. These individuals usually have multiple severe fears, have problems with generalized anxiety, and can also have mood disorders. Individuals with exogenous dental anxiety have acquired or learned this behavior through the external environment. Individuals with exogenous dental anxiety usually have this because of conditioning during traumatic dental experiences. (8)

Dental anxiety is common across many demographics of the population. Females have been found to have a higher level of dental anxiety when compared to males (9). Individuals with lower levels of education experience higher levels of dental anxiety (9–15). The age of onset for dental anxiety has not been researched extensively. One study found that 20% of the study participants reported that dental anxiety started after the age of 14 years (16). Another study found that 33% of the study participants started experiencing dental anxiety during adolescence or adulthood (17).

Dental anxiety is a problem for many reasons. When an individual is anxious about dental work, they are less likely to schedule or appear for their dental appointments. Many of these individuals delay dental treatment until they have a dental emergency. (9,10,18,19) Once a patient with dental anxiety is in the dental chair, they are often difficult to treat. Because of this severe anxiety, misdiagnosis may result (20). Individuals that have a high level of dental anxiety have been reported to have the poorest oral health (10). Patients with dental anxiety have more decay and fewer filled

cavities versus an individual without dental anxiety (21). Individuals with dental anxiety have been found to have more missing teeth than individuals without dental anxiety (22).

Dental anxiety causes individuals to have problems with their dental health. Individuals with dental anxiety have a greater perceived need for dental treatment when compared to those individuals without dental anxiety (23). Individuals with dental anxiety have a greater prevalence of dental related diseases (23–26). These individuals also have a lower health related quality of life versus individuals without dental anxiety (27). Individuals with dental anxiety experience a higher incidence of oral pain, infections, and psychosocial problems. These problems cause problems in their personal lives and in their work environment. (23,25–27) Several studies have used the Oral Health Impact Profile (OHIP) questionnaire to help determine the oral health related quality of life (OHRQoL) in patients with dental anxiety. These researchers found that patients with dental anxiety experience impaired OHRQoL and that their OHRQoL is related to the severity of their dental anxiety. (18,27) Another study concluded from their findings that patients with high levels of dental anxiety had significantly lower scores for OHRQoL and health related quality of life (HRQoL) when compared to individuals with average range of fear about getting dental treatment (28).

Recognizing dental anxiety early in life can enable dental professionals to help manage the patient with dental anxiety and can lead to more successful dental treatment for the patient (29). In order to be successful in managing a patient's dental

anxiety, a tool is helpful to identify dental anxiety. Some of the dental anxiety scales that are available to measure dental anxiety include: Children's Dental Fear Picture Test (30), Corah's Dental Anxiety Scale (CDAS) (31), Modified Child Dental Anxiety Scale (MCDAS) (32), the Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) (33), Venham Picture Test (VPT) (34–36), the Facial Image Scale (FIS) (34), Kleinknecht's Dental Fear Survey (37), Dental Anxiety Question (38), Gatchel's 10-Point Fear Scale (39), Photo Anxiety Questionnaire (40), Dental Anxiety Inventory (41), Adolescents' Fear of Dental Treatment Cognitive Inventory (42), Behavior Profile Rating Scale (43), Spielberger's State-Trait Anxiety Inventory (44), Fear Survey Schedule (45), and the Weiner Fear Questionnaire (46).

Tools used by researchers to measure dental anxiety can be divided into three categories: specific tools to measure dental anxiety in adults, specific tools to measure dental anxiety in children, and general tools that are able to measure dental anxiety in a dental setting (47). Two ways dental anxiety is measured are based on observing behavioral and physiological changes and using self-reported questionnaires and rating scales (48). The most common method at this time for measuring dental anxiety is the use of self-reported questionnaires and rating scales (49–52). Usually a single questionnaire does not adequately evaluate all aspects of a patient's anxiety (49,53). One survey used for dental anxiety is Kleinknecht's Dental Fear Survey (DFS). This survey is a longer questionnaire, more sensitive, and can be used for many different populations (48). This survey consists of 27 items for the patient to answer. The patient

rates each item from 1-5, based on the intensity of their reaction to each question (54). This type of questionnaire is used frequently in researching dental anxiety in adults (48). The Kleinknecht's Dental Fear Survey has been studied for internal consistency of the scale and for test-retest reliability and validity of the questionnaire, all of which are satisfactory (53).

Other dental anxiety scales that are used in dental practice are Corah's Dental Anxiety Scale (CDAS) and the Modified Dental Anxiety Scale (MDAS) (53,55,56). The CDAS has been determined to be a valid, reliable, and useful tool in predicting a patient's anxiety and stress level while in the dental office (57). CDAS measures 4 items. Individuals are asked about four dentally related situations and are then directed to mark the response closest to how they would respond to the situation. (31) CDAS is scored 4 to 20. The higher the score, the higher the anxiety the person has. Scores 15 or greater indicate that the patient has a phobia to dental treatment. (57) CDAS can be used for children and adults (58,59). This tool has been criticized by researchers for not predicting all types of dental fear (60). The MDAS is a more simplified dental anxiety survey and includes a question about the patient's feelings about local anesthetic (61).

Once it is known that a patient has dental anxiety, dental professionals then need to determine a way to decrease the patient's anxiety. There are many ways to decrease a patient's dental anxiety. The use of medications such as anti-anxiety drugs, sedatives, and nitrous oxide are used with patients with dental anxiety. Nontraditional

therapies such as music therapy, essential oils, relaxation techniques, and audio-visual distraction have also been used to reduce dental anxiety.

Some individuals require conscious sedation in order to be able to receive dental treatment due to dental anxiety. Conscious sedation is a "controlled state of low consciousness that conserves protective and unconditional reflexes, permits continuance of a patient's airway impartially, and allows the patient to communicate appropriately to physical and verbal stimuli" (62). Because of this, conscious sedation is very effective in controlling dental anxiety and fear, minimizing uneasiness, and even uncooperativeness in children (63,64). During a dental procedure, conscious sedation decreases pain and anxiety and causes amnesia. Sedation drugs are able to be administered in many ways. Orally, inhalational, intravenous, subcutaneous, intramuscular, and nasal are the ways sedative drugs are able to be administered. (65)

There are many drugs available for conscious sedation use. Some of these include: benzodiazepines, barbituates, ketamine, antihistamines, opioids, and inhalation anesthetics (66). Midazolam is a drug that can be used for short dental procedures. It is an anxiolytic agent. (67,68) Ketamine is another drug used for conscious sedation. Ketamine provides adequate analgesia and amnesia. Ketamine is effective and it also maintains muscle tone and allows the patient to spontaneously breathe as well as maintains the reflexes necessary to breathe. (67,68) The negative effect of ketamine is that it can cause frightening emergent reactions in patients. This makes many dentists and specialists hesitant to use ketamine for conscious sedation. (69,70) Ketamine and

midazolam have equally safe profiles. Ketamine causes more vomiting than midazolam. Both of these drugs are used for conscious sedation. According to one study, these two drugs combined are preferred to fentanyl-midazolam combinations for conscious sedation. (66)

Nitrous oxide is also an option when treating individuals with dental anxiety. Nitrous oxide has been found to reduce anxiety, tenseness, and restlessness. When comparing nitrous oxide with intravenous midazolam, dental anxiety was reduced more with nitrous oxide versus midazolam. Nitrous oxide not only improved dental anxiety, it also reduced irritability and depression. Intravenous midazolam was found to reduce dental anxiety but did not reduce irritability and depression like nitrous oxide. (71)

There are other methods besides the use of medications to treat dental anxiety. These non-traditional therapies have been shown to effectively reduce dental anxiety. The use of essential oils is one of the non-traditional therapies used to reduce dental anxiety. Essential oils have become more popular over the last several years but they have been used in aromatherapy for years.(72) Lavender has been shown to have a sedative effect on individuals (73,74). In one study, orange essential oils were used in a dental office's waiting room to measure the effect of orange essential oil on patients' dental anxiety. When the orange oil was infused into the air of the dental office's waiting room it had an effect on females but not males. The females reported decreased anxiety and improved mood. (75) In another study, orange and lavender essential oil odors were used on patients that were waiting for dental procedures. These essential

oil odors lowered state anxiety, improved mood, and increased calmness in patients. It has been found that orange and lavender essential oils have sedative properties. (76)

Many dental offices today have chosen to use audiovisual distraction to entertain patients and help reduce their fear and anxiety of dental treatment. The use of audiovisual distraction may be beneficial to individuals with mild to moderate dental anxiety. Research has shown that the use of audiovisual distraction may have the opposite effect on patients with high levels of dental anxiety. In one study, researchers studied the effects of the use of a virtual image audiovisual (AV) eyeglass system and what effects it had on patients' dental anxiety and pain. The researchers presented patients that arrived for the prophylaxis appointment with the AV glasses. The patients then watched a video during their dental appointment. The patients reported that they felt less anxiety and discomfort than the control group that did not have the AV eyeglasses or had the option of watching the video. (77)

Music therapy has been found to be useful in many ways. Music therapy is defined by the Music Therapy Association of Ontario as: "the skillful use of music and musical elements by an accredited music therapist to promote, maintain, and restore mental, physical, emotional, and spiritual health" (78). Music can be used for therapeutic purposes. Music therapy can help individuals with mental, neurological, behavioral, physical, psychological, emotional, and spiritual problems. Music therapists are professionals that treat individuals with music therapy. Music therapists treat individuals with many different problems with music therapy. (78) Music has the ability

to make individuals feel emotions. Happiness, sadness, anger, joy, and thankfulness are just a few of the emotions an individual might feel while listening to music. Music has a therapeutic effect on people. Music therapists are able to connect with individuals through music. (79,80)

Music therapy has been shown to decrease anxiety in many stressful situations people experience. Individuals experiencing an event that has an uncertain outcome can experience anxiety. Music has been shown to reduce anxiety before exams and sports competitions (81,82). Listening to music has also been shown to help anxiety in individuals that are in the hospital or in a clinical setting (83–92). Music therapy has been found to be as effective or even more effective in reducing anxiety levels than benzodiazepines (93,94). Studies have shown that individuals suffering from anxiety who listen to music for 10-40 minutes before a procedure significantly reduces anxiety. Music played in these studies have been both patient selected (95–100)and researcher selected (101–104).

Mental illness affects around 20% of the world's children and adolescents (105). Many children with mental health disorders experience emotional, social, behavior, and cognitive problems (105,106). Music therapy is able to help these children cope better with their mental disorders. In one study, children with some type of mental illness were treated with music therapy for 12 weeks. Researchers found that the children's communication improved. Their self-esteem also improved. The children that suffered

with depression found that their depression improved during the 12 weeks of music therapy. (105)

Music therapy is also valuable in treating adults with psychiatric problems. Some psychiatric patients have a difficult time remaining psychiatrically stable. Many individuals with psychiatric problems are on many medications. Sometimes these medications need to be adjusted in order for the patients to remain stable. Researchers have found that group music therapy has had a significantly positive effect on regulating certain medications in psychiatric patients. (107) Music therapy's effects on patients with schizophrenia has also been studied. Music therapy is a psychosocial intervention that has been found to improve social interactions, neurophysiologic function, and psychiatric symptoms and regression in a patient with schizophrenia. (108–112) In one study, the researchers evaluated the effects on group music therapy on behavior, brain waves, and cognitive function in individuals that had chronic schizophrenia. The researchers had patients with schizophrenia participate in 13 group music therapy sessions over seven weeks. After the 13 sessions, the individuals were assessed by electroencephalography to check brain waves, behavior was evaluated by using the Nurses' Observation Scale for Inpatient Evaluation, and the patients' cognitive function was assessed by using the Mini-Mental State Examination. The individuals participating in the group music therapy sessions had more alpha waves than the individuals who did not participate in the group music therapy sessions. The presence of alpha waves indicates joyful emotion. The individuals also showed improvement in cognitive

function. Their positive behavior also increased; social interest, social competence, and personal neatness improved. These patients' negative behaviors decreased during the time of the music sessions. The researchers concluded that music therapy was effective in improving cognitive processing, behavior, and emotional reaction in patients with chronic schizophrenia. (108)

Music therapy has also been found to have a positive effect on behavioral and psychological symptoms of dementia. Researchers found that music therapy decreased anxiety in dementia patients when the individual participated in music therapy for three months or longer. It was also found that music therapy had the greatest effect when compared to other non-pharmacological treatments. (113)

Music therapy has also been used with patients with dental anxiety. Music therapy has been found to successfully reduce dental anxiety in both children (114) and in adults(83). In one study, patients waiting for their dental hygiene appointment were given headsets to listen to music before their appointment. The patients listened to music that was selected by the researchers for 10 minutes. Researchers found in this study that just 10 minutes of music played before a dental hygiene appointment had an anxiolytic effect. Researchers concluded that music listened to with headsets 10 minutes before a dental hygiene appointment was recommended to reduce a patient's dental anxiety. (83)

Music therapy has been found to be successful in reducing dental anxiety when music was listened to by the patient during a dental procedure. In a study of endodontic

patients, 432 Hz music was listened to by the patients throughout their endodontic appointment. Researchers selected instrumental music for this study. The patients in this study that listened to the music reported feeling more relaxed. They also reported that the music was a positive distraction from the noises of the procedure-instruments, equipment, and the voices of the endodontist and the staff. (115)

Dental anxiety can have many physiologic effects on a patient. Some of these effects include: tachycardia, hyperglycemia, hyperthermia, high blood pressure, increased cortisol secretion (116–121), and decrease in salivary flow (122). Music therapy has also had significant results on heart rate, respiratory rate, and blood pressure during a dental procedure. A dental anxiety study done on endodontic patients showed that when the patients listened to music during their endodontic procedure there was a decrease in diastolic blood pressure, systolic blood pressure, and heart rate (115). In another study, patients with dental anxiety attended their dental appointment to have either a posterior tooth extracted or have endodontic treatment. The patients that listened to music before this appointment were found to have decreased blood pressure and decreased temperature. In this study, cortisol in the saliva was also evaluated (116). Cortisol in saliva changes rapidly, within one to two minutes, depending on the level of stress the individual is experiencing (116,123). In this study, patients' saliva was collected during the appointment and a few minutes after the first sound of the drill. The patients' saliva was then collected again after the patients had listened to 20 minutes of instrumental music with headphones. There was a significant

decrease in salivary cortisol in the patients that had listened to the music. Researchers conducting this study concluded that music therapy has a positive effect on reducing dental anxiety and helps decrease salivary cortisol concentrations. (116)

Chapter 2. Methods

This study is an experimental study with three groups-two treatment groups and a control group. This study has a pre-test and post-test design. A total of 30 patients were evaluated to reject the null hypothesis of equality between patients listening to and not listening to music in terms of systolic blood pressure, diastolic blood pressure, and heart rate on the basis of the following assumptions:

1. A power of approximately 90% in rejecting the null hypothesis of equality
2. Expected means at baseline of 139 for systolic blood pressure, 89 for diastolic blood pressure, and 85 for heart rate
3. Expected means gain after music therapy of 120 for systolic blood pressure, 80 for diastolic blood pressure, and 75 for heart rate
4. Standard deviation of 15% from the mean at baseline
5. Overall significance level=5% 2 sided

For the expected means at baseline, the high/normal values of each parameter were considered adequate for the type of population and procedure. The normal values of each parameter were used for the expected means gain after music therapy. The participants in this study were patients of the student clinics at the College of Dentistry at The Ohio State University. Participants in this study were 18 years old or older. They were informed about the study and signed the consent to participate form. Participants were

patients arriving for an appointment for a dental treatment procedure including: prophylaxis, scaling and root planing, composite or amalgam restorations, and crown and bridge preparations. Participants were excluded from this study if they presented to their appointment as a new patient, and if their appointment was for an examination or any form of assessment. Any individual taking any type of anti-anxiety or anti-depressant drugs were excluded. Any patient that requested the use of nitrous oxide for their dental appointment were also excluded from the study.

The independent variable is music or no music. The dependent variables are: Modified Dental Anxiety Scale (MDAS), blood pressure, heart rate, and respiratory rate. The Modified Dental Anxiety Scale (MDAS) was used to determine a participant's dental anxiety level. The Modified Dental Anxiety Scale (MDAS) was given to study participants before dental treatment started and immediately after dental treatment. The MDAS consists of 5 questions. Each question has a rating scale ranging from 1 to 5, indicating "not anxious" to "extremely anxious". The MDAS is a modified version of Corah's Dental Scale, which has four questions about anxiety. The added fifth question addresses the participant's feelings about local anesthetic injections. (2)

The purpose of this study is to evaluate the effects of music on dental anxiety when the patient chooses the type of music and listens to the music throughout the entire dental procedure as compared to listening to no music. The participants arrived for a dental treatment appointment. All participants were informed of the purposes of the study. All participants signed an informed consent to participate and a demographic questionnaire. By computer randomization, participants were assigned to one of three

groups: the Control Group (participants will rest quietly with earbuds during their scheduled dental procedure), Group B (participants will listen to classical/smooth jazz music during their scheduled procedure), or Group C (participants will choose the type of music and listen to it during their scheduled dental procedure). Participants listened to the music with an MP3 player and earbuds. Before the procedure started, participants in all three groups filled out a Modified Dental Anxiety Scale (MDAS). Blood pressure, pulse rate, and respiratory rate were recorded prior to any dental work. After these measures were taken, participants in the treatment groups started to listen to music and the control group rested quietly. After procedure completion, the music was turned off and the earbuds were removed. The participants filled out the Modified Dental Anxiety Scale (MDAS) and blood pressure, pulse rate, and respiratory rate were recorded.

Participants were instructed to complete the demographic questionnaire and dental anxiety questionnaire without the guidance of the examiner. According to the article *Reliability and Validity of the Modified Dental Anxiety Scale (MDAS) in a Turkish population,* the MDAS "showed comparable and high inter-item correlation and internal consistency, high test-retest correlation, and convergent validity" (48). The MDAS has been found to have excellent internal consistency and reliability (124). The Paired t-test, descriptive and inferential statistics, and the repeated-measures ANOVA were used to analyze the data collected.

Chapter 3. Results

A total of 30 male and female adults with a mean age of 41.47 (±21.526) participated in this study. The minimum age was 20 years and the maximum age was 90. Of the 30 participants 15 were female and 15 were male. The participants' income ranged from less than $20,000 annually to $199,999. See Table 1 for annual income statistics. Participants were part of 9 different ethnic groups. 73.3% were Caucasian and 3.3% were from each of the following groups: African American, Middle Eastern, Filipino, Vietnamese, Chinese, Hispanic, Somali, and Cambodian. 96.7% of the participants presented to the student clinics at The Ohio State University College of Dentistry for a prophylaxis appointment. 3.3% presented to the clinics for a periodontal maintenance appointment. The participants had various levels of education. See Table 2 for education statistics.

A repeated measures ANOVA was conducted to compare the effects of music on the three different groups (no music, classical music, and choice of music). This was done by measuring changes in systolic blood pressure, diastolic blood pressure, heart rate, respiration rate, and the Modified Dental Anxiety Scale between baseline and after therapy in groups 1, 2, and 3. There was not a statistically significant difference between pre-procedure and post-procedure or between the groups. See Table 3 for results. The

independent variable, music or no music, did not significantly reduce physiological measures or the MDAS scores.

Chapter 4. Discussion

Dental care can be invasive and has the potential to create dental anxiety. 10-20% of adults in the United States are affected by dental anxiety (5,6). The present study aimed to evaluate the effects of music therapy on dental anxiety. Dental anxiety was measured by the Modified Dental Anxiety Scale (MDAS) and the measurement of pre-procedural and post-procedural systolic blood pressure, diastolic blood pressure, heart rate, and respiration rate. In the present study, we found that there were no statistically significant changes in systolic blood pressure ($p=.175$), diastolic blood pressure ($p=.932$), heart rate ($p=.940$), respiration rate ($p=.246$), or MDAS scores ($p=.560$) between the three groups. We did find a decreasing trend for SBP, DBP, HR, RR, and MDAS scores when comparing pre- and post-procedural values of the two experimental groups.

The current study utilized patients being seen for a dental hygiene procedure by undergraduate dental hygiene students at The Ohio State University College of Dentistry. Another study that utilized dental hygiene patients to study the effects of music on dental anxiety was conducted at the Clinic of Preventive Dentistry, Periodontology, and Cariology at the University of Zurich (83). This study was conducted by Thoma et al (83) who examined the potential anxiety and stress-reducing effect of music on pre-treatment anxiety and stress in patients who were waiting for their scheduled dental hygiene appointment. They conducted a randomized controlled clinical trial and used 92

participants (mean age, 57 years) (83). In our study we utilized 30 participants (mean age, 41). Thoma et al (83) utilized two groups that were selected by computer randomization (83). A control group (the participants waited in silence for 10 minutes prior to their dental hygiene procedure) and an experimental group (participants listened to 'Miserere" by Allegri, a Latin choral piece) were utilized in their study (83). In our study, we used computer randomization to divide participants into three groups: a control group (participants sat quietly during the dental hygiene procedure), group B (an experimental group in which the participants listened to classical music during the dental hygiene procedure), and group C (an experimental group in which participants listened to their choice of music during the dental hygiene procedure). In the study conducted by Thoma et al (83), individuals were called by the experimenters one week prior to their appointment time. At this time, they were informed about the study and asked if they were interested in participating (83). Those individuals that were interested in participating were asked to arrive 30 minutes prior to their dental hygiene appointment (83). In our study, individuals that met the inclusion criteria were asked about their willingness to participate when they arrived for their appointment. In the study by Thoma et al (83), a demographic questionnaire was completed on the experimental day. In our study, the participants also filled out the demographic form on the experimental day. In addition to the demographic form, the participants in our study completed the MDAS before and after treatment. Blood pressure, heart rate, and respiration rate were also assessed before and after the dental procedure. In their study, Thoma et al (83) utilized different stress and anxiety scales than our study. Their participants completed the State-

Trait Inventory (STAI), the trait version of the STAI (STAI-T), the Multidimensional Mood State Questionaire, and a visual analog scale to measure the participant's subjective perception of stress prior to sitting quietly or listening to music for 10 minutes prior to the dental hygiene procedure (83). In their study, Thoma et al (83) completed a repeated-measures ANOVA to determine if over time, there was a difference in state anxiety between groups. They found a significant difference over time ($p=0.006$) (83). They completed a Mann-Whitney U test and compared the delta values between treatment groups and they found a significant difference between the groups, indicating that listening to music was effective in decreasing anxiety ($p=0.007$) (83). They found a significant effect of music listening in the experimental group ($p<0.001$) when anxiety levels from before and after the procedure were compared: prior ($M=33.59$, $SD=8.61$) and after ($M=30.48$, $SD=7.96$) (83). In our study, we did not see a statistically significant decrease in MDAS scores ($p=.560$). We did see a decreasing trend in anxiety when pre-procedural and post-procedural MDAS scores were compared. Our control group's change in anxiety between before and after the procedure was -.10 (prior to procedure: $M=7.10$, $SD=1.79$; after procedure: $M=7.00$, $SD=1.63$). Group B (classical music listening) had a change of -.45 between before and after the procedure (prior to procedure: $M=7.67$, $SD=2.91$; after procedure: $M=7.22$, $SD=2.33$). Group C (group that chose the type of music) experienced the biggest change, -1.27 (prior to procedure: $M=10.18$, $SD=3.46$; after procedure: $M=8.91$, $SD=3.21$). Thoma et al (83) found that the anxiety levels in their control group did not significantly change ($p=0.184$; pre: $M=31.85$, $SD=9.15$, and post: $M=31.22$ and $SD=9.19$). Even though our results did not show a

statistically significant change in anxiety between the groups, it did show a trend of anxiety reduction when participants listened to music during their scheduled dental procedure. Thoma et al (83) utilized a group of participants that was three times larger than our group. Their research showed a statistically significant reduction in dental anxiety when participants listened to music for 10 minutes prior to their scheduled dental hygiene appointment (83). The results of Thoma et al (83) study shows the importance and benefit of music in the reduction of dental anxiety. Music is a cost-effective measure that reduces dental anxiety when compared to the use of prescription drugs, nitrous oxide, and general anesthesia.

In our study we found a decreasing trend when comparing pre-procedural and post-procedural systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and respiration rate (RR) in our experimental groups (Group B and Group C). Di Nasso et al (115) also studied how music affected systolic blood pressure, diastolic blood pressure, and heart rate during a dental procedure. Di Nasso et al (115) conducted a study to test the influences of music on SBP, DBP, and HR before, during, and after endodontic therapy in a population with varying anxiety levels. They used the Corah Dental Anxiety Scale to measure participants' anxiety levels (115). They utilized 100 participants (50 for the control group and 50 for the experimental group) with an age range of 13-83 years (115). Their number of participants was three times more than our study's number of participants (115). Both research studies assigned participants to the control group or experimental groups by randomization. In their study, Di Nasso et al (115) had a control group (no music) and an experimental group (listened to instrumental music). The

endodontic treatment performed on the participants was completed by one of three experienced endodontists (115). This is much different than our study in which all the providers were undergraduate dental hygiene students. In their study, the participants listened to music during the endodontic procedure, which is similar to our study in which the experimental groups listened to music during their dental hygiene procedure (115). Di Nasso et al (115) found that the effect of music had a statistically significant decrease on the SBP (Pr>|t|= 0.0002), DBP (Pr>|t|=<0.0001), and HR (Pr>|t|=,0.0001) when comparing before and after procedure values. In our study, we did not see a statistically significant decrease in these cardiovascular measures. We did see a decreasing trend in these measures among Groups B and C when comparing pre-procedural and post-procedural values.

The sample size for this study was the most significant limitation to the study. In future research on the effects of music on dental anxiety, a larger sample size will need to be utilized. Similar studies to this current study that utilized larger sample sizes obtained statistically significant data that showed that music has a beneficial effect in reducing anxiety during dental procedures (83, 115). In our study we did see a decrease in MDAS scores and cardiovascular measurements when comparing before and after values in the two experimental groups. Another limitation to this study was that we failed to record the type of music that the participants of Group C chose to listen to. We could have used this data to compare the effects of the genres of music chosen. Another limitation to this study was that the participants were all seen by different dental hygiene students with varying psychological approaches to the participants. This could affect dental anxiety levels.

This current study is also limited because it used only patients that were presenting for a dental hygiene procedure. Therefore, these results cannot be generalized to all aspects of dentistry. This study was also affected by the Covid-19 pandemic. Half of the data collection was completed before the pandemic. After a year-long delay due to the pandemic, we were allowed to resume data collection. The Covid-19 pandemic has also increased anxiety related to scheduling and attending medical and dental appointments. It is unclear how this pandemic has affected the results of this study. We calculated the averages of the dependent variables for pre-Covid and post-Covid. See Table 4 for pre-Covid-19 and post-Covid 19 dependent variable statistics.

More research is needed to study the effects of music on dental anxiety when the individuals listen to music during a dental procedure. With future research, studies should include different dental procedures in order to allow generalizations to dentistry as a whole. Also utilizing a limited number of providers for a study would decrease the number of psychological approaches towards patients.

Chapter 5. Conclusion

In this study the participants who listened to either classical music or their choice of music did not have any significant decrease in dental anxiety when compared to the group of participants that sat quietly during the dental procedure. No significant effect of music was found on heart rate, respiration rate, blood pressure, or the MDAS scores. In this study, we found that there was no significant effect of music on dental anxiety when individuals listened to music during their dental procedure.

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Appendix A. Tables

Table 1. **Descriptive statistics by annual income**

	N	**%**
Less than 20,000	**8**	**26.7%**
20,000-34,999	**4**	**13.3%**
35,000-49,999	**3**	**10.0%**
50,000-74,999	**5**	**16.7%**
75,000-99,999	**3**	**10.0%**
100,000-149,999	**3**	**10.0%**
150,000-199,999	**2**	**6.7%**
Missing	**2**	**6.7%**
Total	**30**	**100.0%**

Table 2 **Descriptive statistics by education**

	N	%
High school degree or equivalent	**4**	**13.3%**
Some college but no degree	**7**	**23.3%**
Associate degree	**3**	**10.0%**
Bachelor degree	**10**	**33.3%**
Graduate degree	**4**	**13.3%**
Missing	**2**	**6.7%**
Total	**30**	**100.0%**

Table 3 **Results of MDAS, blood pressure, respiration rate and heart rate before and after treatment**

	Before Appointment-Mean	**After Appointment-Mean**	**Change**	**P-value**
Systolic BP				**.175**
Group 1 (no music)	**119.30±4.57**	**128.10±24.84**	**+8.8**	
Group 2 (classical music)	**124.78±7.38**	**120.44±8.83**	**-4.34**	
Group 3 (choice of music)	**119.82±12.15**	**119.18±11.92**	**-0.64**	
Diastolic BP				**.932**
Group 1	**78.50±6.62**	**78.90±6.64**	**+.4**	
Group 2	**80.78±2.64**	**80.11±3.69**	**-.67**	
Group 3	**75.82±9.86**	**76.73±6.74**	**+.91**	
Heart Rate				**.940**
Group 1	**71.90±10.71**	**70.20±8.65**	**-1.7**	
Group 2	**70.44±9.68**	**66.78±11.25**	**-3.66**	
Group 3	**63.55±7.57**	**57.82±4.05**	**-5.73**	
MDAS Score				**.560**
Group 1	**7.10±1.79**	**7.00±1.63**	**-.10**	
Group 2	**7.67±2.91**	**7.22±2.33**	**-.45**	
Group 3	**10.18±3.46**	**8.91±3.21**	**-1.27**	
Respiration Rate				**.246**
Group 1	**15.40±2.63**	**13.80±1.99**	**-1.6**	
Group 2	**15.56±1.67**	**13.33±1.73**	**-2.23**	
Group 3	**14.73±2.41**	**12.73±2.24**	**-2.0**	

Table 4 Pre-COVID and Post-COVID Statistics

	N	Mean BP 1	Mean HR 1	Mean RR 1	Mean MDAS 1
Data collected pre-COVID	**19**	**122/81**	**70**	**15**	**9**
Data collected post-COVID	**11**	**118/74**	**66**	**16**	**8**