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ORIGINAL RESEARCH
ОРИГИНАЛЬНОЕ ИССЛЕДОВАНИЕ

Impact of three types of music on patients during dental implant surgery and wisdom tooth extractions

Suzan Dagher ✉, **Alexander B. Dymnikov**

RUDN University, *Moscow, Russian Federation*
✉ suzandager@yandex.com

Abstract. *Relevance*. Many patients suffer from anxiety when planning a surgical procedure, which leads them to either postpone it or go through it with all those negative feelings that may affect the course of the surgical work or even its outcomes. Modern medicine aims to find non-pharmaceutical ways, such as music, to put these emotions under control so that the patient feels a sense of calm and tranquility throughout the surgical operation and comes out with less negative feelings and good memories, which prevents the formation of any psychological trauma. Our investigation aims to study the effect of three types of music, on the psychological state of the patient during surgery, by evaluating the data of systolic and diastolic pressure, pulse, and oxygen level in the blood. *Materials and Methods*. 36 patients who visited the Medical Center of the RUDN University on a daily basis for dental implants and wisdom tooth extractions were randomly selected to undergo the experiment. They were divided into four groups, the first was the control group which was not exposed to music, the second was exposed to classical music, the third was exposed to Buddhism music, and the fourth was exposed to music generated by Artificial Intelligence. Pressure, pulse, and oxygen level were recorded in three phases and changes assessed using Student's t-test and Mann-Whitney U analyses. *Results and Discussion.* The final results obtained did not show any significant changes in the values of pressure, pulse, and blood oxygenation during the period of exposure to music when compared with control group. *Conclusion.* Exposing to music didn't show any positive effect on stress levels during dental implantation and extraction.

Keywords: Mozart, AI, buddhism, music therapy, surgery, dental implants, tooth extraction

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Conflicts of interest statement. The authors declare that there is no conflict of interest regarding the publication of this article.

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Ethics approval. The study was approved by the ethics commission of the RUDN University.

Consent for publication. All patients received voluntary informed consent to participate in the study in accordance with the World Medical Association Declaration of Helsinki (WMA Declaration of Helsinki — Ethical Principles for Medical Research Involving Human Subjects, 2013) and the processing of personal data.

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Introduction

Music therapy, also known as therapeutic music, is considered one of the oldest treatment methods used throughout history. Scientific and medical literature mentions the Greeks' use of music in medicine, where they would expose epilepsy patients to musical sounds in order to treat their seizures. Through their experiments, they concluded that music, regardless of its genre, has a therapeutic effect [1].

Other relevant studies have shown the long-term impact of music therapy in alleviating the effects of depression and schizophrenia, as well as its undeniable effect on anxiety and tension resulting from acute psychological conditions, which put the central nervous system in a state of distress [2]. The EEG device indicated an increase in the levels of alpha waves, which are associated with a state of rest and calm, and a noticeable decrease in the levels of beta waves, typically present in stressful situations. Scientists attribute this result to the ability of music to induce a state of calm in patients and divert their attention by stimulating auditory receptors [3].

Looking back in history, we can see that music has played a role in fostering spiritual tranquility and alleviating internal anxiety, as evidenced in the Buddhist religion and the monks' use of music in meditation. This practice has been extensively studied, revealing that Buddhist music is not merely composed of tones with specific frequencies, but rather consists of hymns that safeguard the mind and cultivate peaceful thoughts [4].

When discussing methods that have been used for years and are still applied today to promote clear thinking and a mind free of distractions and tension, Mozart's classical music stands out. This has led to the term "Mozart effect," which has been associated with any musical style that produces the same effect on brain waves (alpha waves) as Mozart's [5].

Feelings have always played a significant role in music composition, as they convey the musician's inner emotions and the intended message to the listener. The listener then interprets these emotions, which can evoke a positive or negative reaction based on various factors, including the depth of emotion the musician infuses into the music. In today's world, where artificial intelligence (AI) significantly influences many areas, particularly in composing music, a crucial question arises: Can computer-generated music evoke a similar impact to that of music composed by humans, such as Mozart, for example [6, 7].

Our investigation aims to study the effect of three types of music, on the psychological state of the patient during surgery, by evaluating the data of systolic and diastolic pressure, pulse, and oxygen level in the blood.

Materials and Methods

The current study was conducted as a randomized controlled study, and was approved by the ethics committee of the relevant institution. 36 patients between the ages of 20 and 60 who attended the Medical Center of the RUDN University for dental implants and wisdom tooth extraction received voluntary informed consent to participate in the study in accordance with the World Medical Association Declaration of Helsinki (WMA Declaration of Helsinki — Ethical Principles for Medical Research Involving Human Subjects, 2013) and the processing of personal data. Excluded from this study were those with hearing

impairment, arrhythmias, patients over the age of 60. These patients were separated into 4 groups, ten patients in the control group and group with classical music, and 8 patients in both of the rest two groups. The control group was not exposed to any music, while the experimental groups were exposed to Mozart's classical music, Buddhism meditation music and music generated by AI.

Three values were measured, which are pressure, pulse, and oxygen level in blood, in three stages. The first stage is when the patient was sitting in the waiting room in a state of rest for ten minutes after his arrival. The previous three values were measured in a row, the second stage of recording took place during the operation at the moment the dental implant was inserted in the case of implantation surgery, and the moment the wisdom tooth was extracted in the case of tooth extraction surgery. The third stage is after the end of placing the last surgical suture. The considered period of time from the beginning of the music playing to the end of the operation is 30 minutes to 1 hour, which is a fixed time period for all patients.

Blood pressure was measured using an automatic tonometer on the wrist (tonometer UB-202, AND company, Russia), pulse and oxygen level measured by medical oximeter fixed on the finger (TI MA company, China). In order to play the music, wireless ear buds were used and the music was played on the mobile device connected via Bluetooth to the ear buds (MarkFlo Ltd company, F9 model, China). It should be noted that all patients who were exposed to music were given the same playlist for some of Mozart's pieces, such as:

- Symphony #40 in G minor, KV. 550: I. Molto Allegro.
- The marriage of Figaro: overture.
- Symphony #35 in D major, k.385.

Whiles for Buddhism music, a playlist for meditation and concentration was used. As for the AI music, the playlist was chosen from an AI website for music generating (AIVA). After adding the keyword 'relaxing 'to the research box, the AI generator suggested few music pieces that were taken in consideration and later on were used in the experiment.

Statistical Analysis

The obtained primary experimental digital data were subjected to statistical processing by generally accepted methods of mathematical statistics. The arithmetic mean, standard deviation, and error of the mean were calculated. The significance of differences between the indicators in the control and experimental group was assessed using Student's t-test with a parametric distribution. For nonparametric distribution, the Wilcoxon test and the Mann-Whitney U test were used. Statistical processing of experimental data was carried out using licensed programs Microsoft Office Excel 2019, Statistica 10.0. Differences were considered statistically significant at a significance level of $P<0.05$.

Results and discussion

The mean age of the 36 patients without group consideration was 39.66 ± 2.439 years. The female/male ratio was 27/9. Oxygen level, pulse and blood pressure in control and investigation groups are represented in tables 1 and 2.

Table 1

Oxygen level and pulse in control and investigation groups

Group	SPO_2			Pulse		
	Before	During	After	Before	During	After
Control	97.70 ± 0.448 %	97.90 ± 0.55 %	98.00 ± 0.49 %	80.10 ± 1.64 (bpm)	79.80 ± 3.57 (bpm)	77.40 ± 2.39 (bpm)
Classic	97.90 ± 0.526 %	97.60 ± 0.427 %	97.40 ± 0.52 %	82.70 ± 3.55 (bpm)	75.60 ± 3.28 (bpm)	75.90 ± 2.86 (bpm)

End of the table 1

Group	SPO_2			Pulse		
	Before	During	After	Before	During	After
Difference with control,%	0.2 %	-0.3 %	-0.6 %	3.2 %	-5.3 %	-1.9 %
AI	98.25 ± 0.31 %	97.25 ± 0.37 %	97.50 ± 0.54 %	79.75 ± 6.5 (bpm)	82.25 ± 5.57 (bpm)	78.00 ± 5.11 (bpm)
Difference with control,%	0.6 %	-0.7 %	-0.5 %	-0.4 %	3.1 %	0.8 %
Buddhism	98.50 ± 0.2 %	97.75 ± 0.37 %	96.88 ± 0.58 %	81.00 ± 2.65 (bpm)	79.00 ± 2.71 (bpm)	76.00 ± 3.05 (bpm)
Difference with control,%	0.8 %	-0.2 %	-1.1 %	1.1 %	-1.0 %	-1.8 %

Notes: SPO_2 is an indication of the oxygen amount being carried by red blood cells in the body, and is measured by a percentage amount. A normal level of oxygen is usually 95 % or higher. Heart rate (pulse) is ideally between 50 and 90 beats per minutes

Table 2

Blood pressure in control and investigation groups

Group	Blood Pressure					
	Before (SBP)	Before (DBP)	During (SBP)	During (DBP)	After (SBP)	After (DBP)
Control	133.70 ± 7.29	88.50 ± 3.64	141.10 ± 7.334	86.00 ± 3.59	137.80 ± 5.70	87.30 ± 3.04
Classic	133.20 ± 8.732	88.20 ± 4.85	126.00 ± 8.99	78.80 ± 5.52	128.40 ± 10.16	80.50 ± 6.35
Difference with control,%	-0.4 %	-0.3 %.	-10.7	-8.4	-6.8	-7.8
AI	106.5 ± 4.770	65.50 ± 3.713	109.00 ± 5.071	71.50 ± 2.471	109.25 ± 4.511	64.75 ± 2.313
Difference with control,%	-20.3 %++	-26.0 %+++	-22.7 %++	-16.9 %++	-20.7 %++	-25.8 %+++
Buddhism	116.25 ± 4.078	78.0 ± 1.547	127.50 ± 5.144	85.25 ± 1.780	131.75 ± 3.272	86.25 ± 0.773
Difference with control,%	-13.1 %	-11.9 %+	-9.6 %	-0.9 %	-4.4 %	-1.2 %

Notes: SBP: Systolic blood pressure; DBP: diastolic blood pressure. Normal range: systolic — less than 120 mm Hg. Diastolic — less than 80 mm Hg

In controlled group, the value of SPO_2 almost remained the same in the three times measurements (before, during, after) and that was 97 ± 1, which means there was no significant differences. As for classical group and for the same values before, during and after, it was 97.90, 97.60, 97.40. In comparison with the controlled group, the difference was less than 1 %.

For AI music, the SPO2 values divided in times measurements are as follows: 98, 97, 97. In comparison with controlled group, the difference before 0.6 %, during 0.7, and after 0.5, which leads us to the same conclusion as previews, the conclusion that says that there is no difference between this group and the controlled group.

As for Buddha music, the values are 98 ± 2 in all three times measurements, and in comparison with controlled group, it is as followed; 0.8,0.2,1.1. This also leads us to the same conclusion as above.

When reading the values for the pulse of the four groups, we can say that in controlled group, the values had changed as follows; 80, 79, 77. And for classic group, it is as follows; 82, 75, 75. In comparison, it is obvious that changes are not that significant. As for AI; 79, 82, 78. And for Buddha; 81, 79, 76. In general, we can say that the changes of oxygen levels and pulse for all three groups, and comparing these values with controlled group, and within the same group, changes are hardly noticeable.Blood pressure values are also measured three times, before, during, and after. Starting with controlled group, blood pressure in the starting period was 133/88, and then got increased during the operation (141/86), and then slightly decreased (137/87).

As for classic group, before starting the music, the mean of pressure was 133/88, and then notably got decreased to 126/78, and then scored 128/80 at the end of the operation. In comparison with controlled group, we can see that there is almost no difference.

In AI, the mean of pressure before was 106/65, during 109/71, and after 109/64, even though this shows some sort of change within the group on three stages, but we can still say that the pressure kept a stable value throughout the experiment. For Buddha music, there was negative changes, as it started with 116/78, and during 127/85, and ended with 131/86. This shows an increase in blood pressure all the way from the very begging to the end. In view of the previous results, and in comparing with controlled group, we can see that the AI music has the most significant effect on the stress levels during and after the operation with means of –22 during and –25 after the operation for blood pressure, meanwhile for the Buddha music, the numbers show –9 during and –1.2 after in comparison with the controlled group. As for classical music –10 during and –7 after.

There is no doubt that music plays a role in alleviating the symptoms of stress and anxiety that result from undergoing surgical procedures, although this effect is small and may not be readily apparent in the statistical results. There are numerous factors that contribute to evaluating the impact of music on individuals, including their level of interest in the genre of music used, as well as the individual's gender, age, and religious beliefs [8]. All of these individual factors must be taken into account, recognizing that it is impossible to describe specific universal music for anxiety, although there have been several attempts in the literature [9, 10].

It is believed that the calming effect of music is attributed to the suppression of the sympathetic nervous system, resulting in a reduction of adrenergic activity and decreased neuromuscular excitability [3].

Wright found that classical music is highly effective in relieving moderate-level anxiety [11]. However, there are studies that have confirmed that there are no clear differences [12].

In our study, the final results demonstrate the impact of music from three different eras on the state of mind and inner peace, which are the primary objectives of our study. In conclusion, it is evident that AI-generated music is leading in reducing stress levels, as indicated in the pressure table above.

In contrast, there were not many differences in pulse and PSO_2 when compared with the control group, and within the group itself in the results obtained before, during, and after the investigation.

Limitations

There are some limitations in this study, one of which is the type of music used. The music, specifically Buddha music, may be unfamiliar to Russian citizens as it is rarely heard except in cases of meditation exercises. Therefore, it was unusual to use this type of music with the aim of alleviating the anxiety resulting from undergoing surgical work. These shifts in internal experience and brain functioning can change how individuals cope with life's challenges, leading to stress, such as that

experienced during surgeries. There are still unpleasant events happening, but they do not overwhelm anyone. This study was suggested by college students who practiced meditation throughout the semester. At the end of the semester, during finals week, they exhibited higher brain integration and lower stress reactivity, despite the high stress levels during finals week [13].

Other limiting factors include the age of the patients and their familiarity with the planned procedure. Regardless of the music used, patients undergoing dental implantation for the first time did not experience much reduction in anxiety. In such cases, familiar music could have been more helpful.

According to the authors' opinion, the vital signs that were measured are not sufficient to explain the results we obtained, and therefore, we propose devices to measure other indicators, such as health tracker device to measure stress levels, since there is no doubt that Buddha's music has an effect on psychological comfort and relaxation, and this A scientifically proven fact, but what our results have shown neither confirms nor denies this fact.

Another factor to consider is the way the patient was exposed to music. In our study, we utilized headphones, which caused discomfort for the patients due to the perception of being isolated from surrounding noises. This was primarily driven by the fear of missing something or the desire to maintain control over everything happening around them.

We recommend further studies to explore the potential of using speakers instead of headphones to reduce anxiety levels. Additionally, it is important to consider the use of AI music, as our study suggests that it may have a better impact. This type of music is widely used nowadays and is more favorable for younger patients.

Conclusion

This study suggests that listening to music, regardless of the genre, reduces dental anxiety, even if the effect is barely noticeable. We selected these three music genres based on the findings in literature regarding their potential impact on stress levels. We also took a chance with AI-generated music to explore the extent to which computer-generated music can substitute for human-made music. This decision was influenced by recent events such as the recreation of Beethoven's symphony and the use of AI to assist in creating the 'Tokyo 2020 beat', the official anthem of the Tokyo Olympic Games, which have garnered media attention.

References / Библиографический список

1. Jenkins J.S. The Mozart effect. *Journal of the royal society of medicine.* 2001;94:170–172. doi: 10.1177/014107680109400404.
2. Domante Kucikiene, Ruta Praninskiene. The impact of music on the bioelectrical oscillations of the brain. *ACTA medical lituanica.* 2018;25(2):101–106. doi: 10.6001/actamedica.v25i2.3763
3. Schienle A, Scharmüller W, Leutgeb V, Schäfer A, Stark R. Sex differences in the functional and structural neuroanatomy of dental phobia. *Brain Struct Funct.* 2013;218:779–787. doi: 10.1007/s00429–012–0428-z
4. Misra S, Shastri I. Rumination of Music on Buddhism and Hinduism. *International Journal of Human Movement and Sports Science*. 2014;2(3):33–40. doi: 10.13189/saj.2014.020301
5. Jaušovec N, Jaušovec K, Gerlič I. The influence of Mozart's music on brain activity in the process of learning. Clinical neurophysiology. 2006;117(12):2703–2714. doi: 10.1016/j.clinph.2006.08.010
6. Civit M, Civit-Masot J, Cuadrado F, Escalona MJ. A systematic review of artificial intelligence-based music generation: Scope, applications, and future trends. *Expert Systems with Applications.* 2022;118190. doi: https://doi.org/10.1016/j.eswa.2022.118190
7. Ragot M, Martin N, Cojean S. Ai-generated vs. human artworks. a perception bias towards artificial intelligence? *InExtended abstracts of the 2020 CHI conference on human factors in computing systems.* 2020;25:1–10. doi: 10.1145/3334480.3382892
8. Gulnahar Y, Kupeli I. Effect of Different Kinds of Music on Anxiety During Implant Surgery in Turkey: Randomized Controlled Study. *International Journal of Oral & Maxillofacial Implants*. 2020;35(4). doi: 10.11607/jomi.8329
9. Maulina T, Djustiana N, Shahib MN. The effect of music intervention on dental anxiety during dental extraction procedure. *Open Dent J.* 2017;11:565–572. doi: 10.2174/1874210601711010565
10. Fachner J, Gold C, Erkkilä J. Music therapy modulates fronto-temporal activity in rest-EEG in depressed clients. *Brain Topogr.* 2013;26(2):338–354. doi: 10.1007/s10548–012–0254-x
11. Wright H. The correlation of classical, jazz, and pop music to a reduction of dental anxiety experienced by adult patients. *Undergraduate Honors Thesis Collection.* 2018:437.
12. Wong H, Lopez-Nahas V, Molassiotis A. Effects of music therapy on anxiety in ventilator-dependent patients. *Heart Lung.* 2001;30:376–387. doi: https://doi.org/10.1067/mhl.2001.118302
13. Nidich SI, Rainforth MV, Haaga DA, Hagelin J, Salerno JW, Travis F, Tanner M, Gaylord-King C, Grosswald S, Schneider RH. A randomized controlled trial on effects of the Transcendental Meditation program on blood pressure, psychological distress, and coping in young adults. *American journal of hypertension.* 2009;22(12):1326–1331. doi:10.1038/ajh.2009.184

Влияние трех видов музыки на пациентов во время дентальной имплантации и удаления зубов мудрости

С. Дагер ✉, А.Б. Дымников

Российский университет дружбы народов, *г. Москва, Российская Федерация*
✉ suzandager@yandex.com

Аннотация. *Актуальность.* Многие пациенты испытывают тревогу при планировании хирургической процедуры, что заставляет их либо откладывать ее, либо переживать ее со всеми теми негативными ощущениями, которые могут повлиять на ход хирургической работы или даже на ее результаты. Современная медицина стремится найти нефармацевтические способы, такие как музыка, для того, чтобы поставить эти эмоции под контроль, чтобы пациент на протяжении всей хирургической операции ощущал чувство спокойствия и умиротворения и выходил с меньшим количеством негативных чувств и хороших воспоминаний, что препятствует формированию любой психологической травмы. Целью нашего эксперимента является изучение влияния трех видов музыки на психологическое состояние пациента во время операции путем оценки данных систолического и диастолического давления, пульса и уровня кислорода в крови. *Материалы и методы.* Для проведения эксперимента были случайным образом отобраны 36 пациентов, ежедневно посещавших Медицинский центр Российского университета дружбы народов для проведения дентальной имплантации и удаления зуба мудрости. Они были разделены на четыре группы: первая была контрольной группой, которая не слушала музыку, вторая — классической музыкой, третья — буддийской музыкой, а четвертая — музыкой, созданной искусственным интеллектом. Давление, пульс и уровень кислорода регистрировались в три фазы, а изменения оценивались с помощью Student's t-test и Mann-Whitney U анализы. *Результаты и обсуждение.* Полученные окончательные результаты не показали каких-либо существенных изменений показателей давления, пульса и оксигенации крови в период воздействия музыки по сравнению с контрольной группой. *Выводы.* Воздействие музыки не оказало никакого положительного влияния на уровень стресса во время имплантации и удаления зубов.

Ключевые слова: Моцарт, AI, буддизм, музыкотерапия, хирургия, зубные имплантаты, удаление зубов

Информация о финансировании. Исследование не имело гранта от финансирующих агентств в государственном, коммерческом или некоммерческом секторах.

Вклад авторов. Дагер С. — концепция и дизайн, подробный поиск литературы, сбор данных, интерпретация и анализ данных, написание статьи. Дымников А.Б. — разработка концепции и дизайна, редактирование и окончательное утверждение версии для публикации. Все авторы прочитали и одобрили окончательный вариант рукописи. Информация о конфликте интересов.

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Corresponding author: Suzan Dagher — PhD student of the Department of Oral and Maxillofacial Surgery and Surgical Dentistry, Institute of Medicine, RUDN University, 117198, Miklukho- Maklaya str., 10, Moscow, Russian Federation. E-mail: suzandager@yandex.com
Dymnikov A.B. ORCID 0000–0001–8980–6235
Dagher S. ORCID 0009–0004–1950–4011

Ответственный за переписку: Дагер Сузан — аспирант кафедры челюстно-лицевой хирургии и хирургической стоматологии, медицинский институт РУДН, Российская Федерация, 117198, г. Москва, ул. Миклухо-Маклая, д. 10. E-mail: suzandager@yandex.com
Дымников А.Б. SPIN 7254–4306; ORCID 0000–0001–8980–6235
Дагер С. ORCID 0009–0004–1950–4011