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Effectiveness of binaural beats in reducing preoperative dental anxiety

B.K. Isik [a,*], A. Esen [a], B. Büyükerkmen [b], A. Kilinç [a], D. Menziletoglu [a]

[a] *Necmettin Erbakan University, Faculty of Dentistry, Oral and Maxillofacial Surgery Department, Konya, Turkey*
[b] *Necmettin Erbakan University, Faculty of Dentistry, Prosthodontics Department, Konya, Turkey*

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Abstract

Binaural beats are an auditory illusion perceived when two different pure-tone sine waves are presented one to each ear at a steady intensity and frequency. We evaluated their effectiveness in reducing preoperative anxiety in dentistry. Sixty patients (30 in each group) who were to have impacted third molars removed were studied (experimental group: 20 women and 10 men, mean (range) age 24 (18-35) years, and control group: 22 women and 8 men, mean (range) age 28 (15-47) years). All patients were fully informed about the operation preoperatively, and their anxiety recorded on a visual analogue scale (VAS). The local anaesthetic was given and the patients waited for 10 minutes, during which those in the experimental group were asked to listen to binaural beats through stereo earphones (200 Hz for the left ear and 209.3 Hz for the right ear). No special treatment was given to the control group. In both groups anxiety was then recorded again, and the tooth removed in the usual way. The paired *t* test and *t* test were used to assess the significance of differences between groups. The degree of anxiety in the control group was unchanged after the second measurement ($p = 0.625$), while that in the experimental group showed a significant reduction in anxiety ($p = 0.001$). We conclude that binaural beats may be useful in reducing preoperative anxiety in dentistry.

Keywords: Binaural beats; anxiety; dental anxiety; preoperative anxiety; dental fear; oral surgery

Introduction

Anxiety is an emotional state that precedes a threatening encounter, which sometimes is not even identifiable,[1] and is common both for dental patients and professionals. It can prevent patients making regular visits to the dentist, and it has the potential to affect their quality of life.[2,3] It can evoke physical, cognitive, emotional, and behavioural responses, and managing such patients is stressful for many dentists.[4] Because anxiety is often closely linked to painful stimuli and increased perception of pain, affected patients experience more pain that lasts longer, and they need more analgesics.[1,5] Psychotherapeutic or pharmacological interventions, or both, have been suggested to deal with it.[1]

Binaural beats occur when two sounds with steady intensities but different frequencies are presented separately, one to each ear. The resulting perception is of a single tone with a frequency that is midway between the two carrier tones and that waxes and wanes in amplitudes at a rate equal to the difference between them. They require the combined action of both ears.[6] Their use is not new and much research has been done,[7] but we know of no report of their use in dental anxiety.

In this prospective randomised clinical study we investigated the efficacy of binaural beats on anxiety among patients about to have impacted third molars removed.

* Corresponding author at: Necmettin Erbakan Üniversitesi, Dis Hekimligi Fakültesi, Konya, Turkey. Tel.: +90 332 220 00 25, Fax: +90 332 220 00 45.
E-mail address: kisik@konya.edu.tr (B.K. Isik).

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Patients and method

The study was approved by the local ethics committee (approval number 41980859/050.01). Inclusion criteria were having a fully impacted mandibular third molar tooth that required removal, and being otherwise healthy. Patients who had psychiatric or hearing disorders or epilepsy, or who were taking antidepressants, anticonvulsants, or opioids, were excluded. We included 60 volunteers who were randomly divided into experimental and control groups (n = 30 in each). There were 20 women and 10 men in the experimental group, whose mean (range) age was 24 (18-35) years, and 22 women and 8 men in the control group, whose mean (range) age was 28 (15-47) years. Randomisation was by the toss of a coin.

Before the operations all patients were told that they had an impacted tooth that needed to be removed. The operation was outlined (without getting graphic), and it was explained that postoperatively they could expect some pain, swelling, and temporary inability to open the mouth completely. They then recorded their degree of anxiety on a visual analogue scale (VAS), which has previously been shown to be a valid way in which to evaluate dental anxiety.[8–10] This scale comprised a 100 mm horizontal line drawn on paper, the left-hand end of which was marked "no anxiety at all", and the right-hand end "worst anxiety imaginable". There were no other expressions or numbers on the line. Patients were asked to make a mark that indicated their degree of anxiety on the line, which was measured (mm) from the left-hand end. This record was labelled "first measurement".

In the control group, the local anaesthetic was given, and they waited for 10 minutes. During this period, nothing was done, there was no background music or noise, and we did not talk to the patient about the operation. The operating room and table was prepared in the usual way. After the 10 minute' period was over, patients' anxiety was recorded again. This was labelled "second measurement".

In the experimental group the local anaesthetic was given and the patient was asked to listen to binaural beats through stereo earphones (200 Hz for the left ear and 209.3 Hz for the right ear). The frequencies were produced by software (Brain Waves Binaural Beats, MynioTech Apps, Chapeco, Santa Catarina, Brazil) running on a mobile device (Samsung Galaxy S II, Samsung Electronics Co Ltd, South Korea). The patients were allowed to adjust the volume as they wished. The binaural beats that we used were "pure" frequencies: that is, there was no background music or another soothing sound such as rain drops or waves. After the patient had listened to 10 minutes of binaural beats, the earphones were taken off and the anxiety recorded again. This was labelled "second measurement" in the experimental group.

All patients were instructed not to close their eyes during the waiting period, as this could affect the natural brainwaves and interfere with our results. The operations were then continued in the usual way. The type of incision, volume, and type of local anaesthetic were the same in both groups.

Table 1
Mean (SD) first and second visual analogue scores for anxiety in experimental and control groups (n = 30 in each).

Measurement	Experimental	Control
First	5.37 (2.12)	5.52 (2.42)
Second	3.59 (2.23)	5.39 (2.65)
p value	<0.01	0.625

Statistical analysis

We used SigmaPlot 12.5 (Systat Software Inc, San Jose, CA, USA) for statistical analyses. The data were tested for normality with the Shapiro-Wilk test. The data satisfied the requirements for parametric tests, so the significance of differences between the groups was assessed with the aid of the paired *t* test and intergroup comparisons were assessed with the *t* test. Probabilities of 0.05 or less were accepted as significant.

Results

At the first measurement there was no significant difference (p = 0.402) between the anxiety felt in the experimental and control groups (t = −0,250, df 58; 95% CI of the difference between means −1.323 to 1.030; difference = −0.147). At the second measurement the difference between the two groups was significant (p = 0.006), the experimental group having less anxiety (Table 1) (t = −2.843, df 58; 95% CI −3.061 to −0.532; difference = −1.797). As we could find no similar report elsewhere we considered our research as a pilot study and made a post hoc power analysis, which showed a power of 0.88 at an α of 0.05.

On within-group analyses there was a significant decrease (p < 0.001) in anxiety in the experimental group (t = 7.258, df 29; 95% CI for difference of means 1.278 to 2.282; difference between means = 1.780). However, in the control group there was no significant difference (p = 0.625) between the first and second measurements (t = 0.494, df 29; 95% CI for difference of means −0.408 to 0.668; difference between means = 0.130).

Discussion

Treating an anxious patient is stressful. Cooperation is poor, treatment takes longer, and it is likely to be an unpleasant experience for both patient and dentist.[4]

The physiological effects may include feelings of exhaustion after a visit to the dentist, while the cognitive impact can involve unhelpful thoughts, beliefs, and fears, together with avoidance and other behaviour related to eating and oral hygiene. Disturbances of sleep and social interactions,

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