

# Binaural Beats as a Non-Pharmacological Intervention to Treat Dental Anxiety in Pediatric Dental Patients

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## Introduction

Dental anxiety is a common issue affecting a significant portion of the pediatric population, often manifesting as increased heart rate and poor behavior during dental visits. Children having dental anxiety usually hesitate to accept dental care which can result in poor oral health and may lead to expensive and complex dental treatment in the future. Therefore, the search for non-pharmacological, easily implementable interventions is critical.

One such intervention gaining attention is the use of binaural beats. Binaural beats are auditory illusions perceived when two tones of slightly different frequency are presented separately through stereo headphones. The brain perceives the difference and this frequency is thought to entrain (synchronize) the brain's own electrical activity to that rate. Frequencies associated with relaxation, such as Theta (4-8 Hz) and Alpha (8-12 Hz), have been studied for their potential to induce a meditative or relaxed state, and reduce cardiovascular and neuroendocrine response during acute stress situations.

## Study Objectives

This study aims to investigate the effect of binaural beats delivered via headphones, on the heart rate of children during dental treatment.

## Methods

### Participants

A total of 25 children (ages 5 to 9 years) were recruited from Union Community Health Center and SBH Health System. Inclusion criteria required parental consent and patients with no existing dental experience scheduled for similar bilateral dental procedures. Exclusion criteria included pre-existing cardiac conditions or diagnosed hearing impairment.

## Data Collection

Each participant attended two appointments, scheduled at the same time of day to control for circadian rhythm effects. The order of conditions (Control vs. Binaural Beats) was randomized across the participants to mitigate order effects.

Visit 1 (Control): The child was seated in the dental chair. After a 5-minute acclimation period, treatment began. The child wore noise-canceling headphones with no audio to account for the physical presence of the equipment.

Visit 2 (Intervention): The child was seated in the dental chair. After acclimation, they listened to a binaural beat embedded in calm, ambient music via noise-canceling headphones throughout the duration of the treatment. (Image 1).

Heart rate (BPM) was measured using a medical-grade pulse oximeter attached to the child's non-dominant index finger. Measurements were recorded at: T0 Baseline (pre-treatment) and Every 5 minutes during active dental work (Sealants, Restorations, Stainless Steel Crowns, Extractions). This resulted in 120 paired heart-rate observations across participants and time points.



Image 1: Patient during the intervention visit

All statistical analyses were performed using paired-samples comparisons, as heart rate(HR) was measured repeatedly within the same participants under two experimental conditions.

## Results

A paired-samples *t*-test was conducted to compare heart rate between the control and binaural beats conditions.

Mean heart rate was significantly lower during the binaural beats condition (M=85.62BPM, SD=7.21) compared to the control condition (M=89.38BPM, SD=7.42). The mean reduction in heart rate was 3.76 BPM. (Table 1).

The paired *t*-test indicated that this difference was statistically significant,  $t(119)=9.34, p<0.001$ .

These findings demonstrate a statistically significant reduction in heart rate when children were exposed to binaural beats during dental treatment. The results suggest that binaural beats may reduce physiological markers associated with dental anxiety in pediatric patients.

## Discussion

This study investigated the effect of binaural beats on heart rate in children undergoing dental treatment. The findings demonstrate a statistically significant reduction in heart rate during the binaural beats condition compared to the control condition.

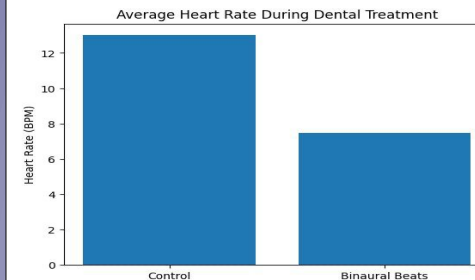


Table 1: Average Rate During Dental Treatment

On average, children exhibited a 3.76 BPM decrease in heart rate when listening to binaural beats. Given that elevated heart rate is a well-established physiological indicator of anxiety and sympathetic nervous system activation, these results suggest that binaural beats may meaningfully attenuate stress responses during pediatric dental procedures.

This intervention is non-invasive, low-cost, and easy to implement in routine clinical practice, unlike pharmacological approaches. This technique doesn't have any medication-related risks and requires minimal training or equipment.

However, several limitations should be acknowledged. The sample size was modest, and heart rate was the sole physiological outcome measure. Behavioral measures of anxiety, subjective anxiety scales, and additional biomarkers were not included and may provide a more comprehensive assessment of the intervention's effects. Future research with larger, more diverse samples and multimodal anxiety assessment is warranted to confirm and extend these findings.

## Conclusion

In conclusion, binaural beats appear to be a promising strategy for reducing dental anxiety in pediatric patients. Incorporating this simple intervention into clinical practice may improve the dental experience for children and potentially enhance cooperation, treatment efficiency, and long-term oral health outcomes.

## References

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