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A COMPARATIVE EVALUATION OF BINAURAL BEATS AND 432 Hz MUSIC, TO REDUCE DENTAL ANXIETY IN CHILDREN: A COMPARATIVE STUDY

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ABSTRACT

BACKGROUND: The single, universal, effective method to overcome dental anxiety is unknown. Although several pharmacological alternatives are available, the current trend is to try to decrease anxiety by non-pharmacological intervention. Music therapy is slowly gaining acceptance as a non-pharmacological anxiolytic intervention among healthcare professionals. The study focuses on this modern method, so as to alleviate the child's dental anxiety and improve the cooperation of pediatric patients in the dental practice. **AIM:** To compare the anxiolytic effects of binaural beats and 432Hz music in reduction of anxiety in children.

METHODOLOGY: 33 patients will be recruited and randomly allocated to the binaural beats group, 432Hz music group and a control group. Preoperative assessment will be done using anxiety scales such as Raghavendra, Madhuri, Sujata pictorial scale (RMS-PS) and Frankl behavior rating scale (FBRS). The physiological parameters such as pulse rate and oxygen saturation will also be used to evaluate dental anxiety (first measurement). Patients will listen to the respective music using headphones for 10 minutes. Respective scores will then be recorded both groups for the second time. Local anesthesia (LA) will be given to all patients. After LA, a final measurement will be recorded and all the scores will be maintained in a data collection table.

RESULTS: Results revealed a gradual decline in the RMS-PS scores, improvement in behavior in terms of FBRS scores in the binaural beats and 432Hz music group. No such changes were observed in the control group. There was also a reduction in pulse rate observed in both binaural beats and 432 Hz music group conveying an alleviation of anxiety in the children of these groups

CONCLUSION: This study revealed that both binaural beats and 432 Hz music were successful in reducing dental anxiety in children. It can be concluded that both music groups are effective aids to relieve anxiety in pediatric patients

KEY WORDS: Binaural beats, Dental anxiety, 432 Hz music

INTRODUCTION:

Dental anxiety is a sense of apprehension associated with receiving dental treatment, which may or may not be associated with a specific external trigger. The stress associated with receiving dental treatment, often causes the child to find means to steer clear of dental treatment. Pediatric dental practitioners employ various strategies to allow the child to endure the stress associated with dental treatment and subsequently improving acceptance towards it. The management of an anxious child begins with anxiety assessment. The anxiety assessment acts as a guide to facilitate efficient management of dental anxiety in pediatric patients. ^[1]

Music therapy may be considered as a forerunner, amongst the various strategies that are being employed for anxiolysis. Music has the potential to elicit several emotional responses in humans that include emotional changes and upliftment of mood.^[2] Several studies have shown that the alterations in emotions and moods after listening to music, are strongly correlated with the regulation of the physiological system. This implies that music holds potential to cause alteration in physiologic parameters of heart and respiration rate.^[3] Relaxing music can suppress stress-associated increase in heart rate and amplitude of Heart Rate Variability, which are indices of parasympathetic nerve activity.^[3]

This study focuses on two forms of music therapy namely the binaural beats technology and 432 Hz music technology. Binaural beats were initially identified in 19th century and was studied in detail by Osler in 1973. The 'Binaural beats' technology is represented by two sounds with similar intensities but varied frequencies that are delivered separately to each ear.

This is interpreted as a single tone with a frequency that is a net result between the two original tones. This tone waxes and wanes in an amplitude at a rate that equals the difference between them^[5,6]. It is essential that both hearing organs participate in the process for the sake of achieving satisfactory results. Appropriate vibrations and localization are created by the brain in response to these tones. If the difference in frequency exceeds 30 Hz, the two tones are perceived separately, as a result of which the observer may not be able to discern the beats.^[7]

Binaural beats have been successful in abating anxiety. Padmanabhan, Hildreth and Laws in 2005 measured brain wave entertainment following the use of binaural beats and observed that the electrical waves are produced within the brain in response to two analogous tones interpreted separately by each ear. Since the rhythm equals the difference of two tones it can be a source of entertainment throughout the brain. These frequencies can produce particular Electroencephalography associated states, which has the potential to alleviate moderate anxiety. The music of 432 Hz frequency is closest to the natural human frequency. Music with slow and melodious notes has the potential to provide emotional and physical relaxation. Steelman identified that music was therapeutic and reduced blood pressure of patients posted for treatment under local anesthesia. Studies have shown that musical intervention caused normalization of arrhythmias and hence exert influence on alleviating anxiety amidst operation under local anesthesia.^[8]

It is true that there is a lack of literature about binaural beats and 432 Hz in pediatric dental patients. Thus, the study attempts to investigate the effectiveness of 432 Hz music and binaural beats for reducing dental anxiety in children. The objective of the study was to evaluate the effect of binaural beats and 432 Hz music in children with dental anxiety and compare the effects of 432 Hz and Binaural beats in children with dental anxiety.

MATERIALS AND METHODS

This double blinded study was conducted in the Department of Pediatric and Preventive Dentistry, Bharati Vidyapeeth Dental College and Hospital, Sangli between 08 May 2022 and 08 August 2022. This clinical study has been registered in Clinical Trials Registry of India with reference number CTRI/2022/10/046765 and has also been approved by the institutional ethical committee with reference number BV (DU) MC&H/Sangli/IEC/D-79/22.

The study included patients aged of 8-12 years who portrayed negative behavior when assessed by Frankl's behavior rating scale and required administration of LA for pulp therapy of mandibular posterior teeth. The study excluded patients with hearing defects, systemic conditions and special healthcare needs.

Sample size estimation was done using Statistical Package for Social Sciences software. The results suggested a total sample size of 33. The recruited participants upon entering the dental set-up were then randomly allocated by assistant into three groups by using sealed envelopes with numbers to aid in segregation into the groups namely the binaural beats, 432 Hz music group and the control group. These participants were then subjected to an initial anxiety assessment using the RMS-PS scale. (figure 01) This was done by asking the children to choose the face they feel like about themselves at that moment.

Both investigator (pedodontist) and participant were blinded. The investigator (pedodontist) objectively analyzed the child's behavior using the FBRS, whilst simultaneously monitoring the child's pulse rate using a pulse oximeter (Medtech Oxyguard, Mumbai, India)

The patients were made to listen to the music of allotment, for 10 minutes using headphones at a volume acceptable to the child. In the binaural beats group, beats of 220

Hz for right ear and 210 for left ear which were generated by software(Brain waves binaural beats, Myniotech Apps, Santa Catarina, Brazil) was played using the mobile device(iPhone 7 plus, apple,USA) and in the 432Hz music group the song summer(by Stefano Crespan Shantam) was played using the mobile device(iPhone 7 plus, apple,USA). The anxiety assessment (second) was again repeated using RMS-PS scale, FBRS and pulse monitoring. An administration of local anesthesia injection (inferior alveolar nerve block) was then done for the pulp therapy.

A final anxiety assessment was recorded after local anesthesia administration using the RMS-PS, FBRS and pulse monitoring. The study concluded with the recording of all the acquired data and statistical analysis of the collected data, to draw a conclusion. The readings collected in the data collection table. Data obtained was compiled on a Microsoft Office Excel Sheet (version 2019, Microsoft Redmond Campus, Redmond, Washington, United States). Statistical analysis was conducted using SSPS software

STATISTICAL ANALYSIS

Descriptive statistics like frequencies and percentage for categorical data, Mean & Standard Deviation for numerical data had been depicted. Normality of numerical data was assessed using Shapiro-Wilk test as the data did not follow a normal distribution curve. Non-parametric tests were used for comparisons. Inter group comparison (3 groups) was done using Mann Whitney U test. Intra group comparison was done using Friedman's (for >2 observations) followed by pairwise comparison using Wilcoxon Signed rank test. Comparison of frequencies of categories of variables with groups & with time intervals was done using chi square test. For all the statistical tests, $p < 0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

RESULTS

Thirty-three patients between 8-12 years of age were included. There was no statistical difference in all the groups which were used to measure the anxiety before the procedure (first measurement) amongst all three groups. The graph shows decline in the RMS-PS scores between the initial anxiety measurement and final anxiety measurement in binaural beats and 432 Hz music. No such decline is observed in the control group. (Graph 01). The FBRs scores reveal a gradual improvement in the behavior of the children in binaural beats and 432 HZ music groups, but no such improvement was seen in control group. (Graph 02,03,04). The graph depicts the reduction in pulse rate between the initial measurement and final measurement, in the binaural beats and 432Hz music group which in turn correlates with alleviation of anxiety. No reduction was observed in the control group (Graph 05)

DISCUSSION

Eliminating dental anxiety requires a tailored approach based on the needs and fears of the child.^[9] Although, the utilization of analgesic and sedatives maybe considered as an effective approach, it is only prudent to consider other non-pharmacological methods to decrease anxiety.^[9] Amongst a wide array of non-pharmacological methods, music therapy, is slowly gaining acceptance among healthcare professionals. Clinical researches highlight that music may influence emotions and give optimistic results.^[9]

Numerous scales have been used in an attempt to grade anxiety. The current study utilizes both RMS-PS and FBRs in order to comprehensively evaluate the child's anxiety levels in a subjective and objective manner.^[12] The RMS-PS scale encompasses five faces whose emotions may range from extremely joyous to remarkable dissatisfaction and vehement crying.^[12] The scale includes two separate collection of photos for boys and

girls, in attempt to promote gender inclusivity and thus the child resonates better with the images. Neoteric studies imply that RMS-PS is a reliable scale for evaluation of dental anxiety.^[12]

The soundness of the RMS-PS scores may be substantiated by its compelling correlation with the Venham Picture Test scores. .^[12] The RMS-PS has many superior features when compared with former anxiety assessment measures. It offers a hassle free and efficient method of anxiety evaluation for a pediatric dental patient.^[12] The FBRS method serves as a benchmark in behavior evaluation scales. This may be a result of its widespread usage and popularity in researches of pediatric dentistry.^[13] Both scales enhance the accuracy of assessment in the present study.^[14]

In the available literature only one research has been conducted to evaluate dental anxiety with binaural beats and 432 Hz music and no such study has been conducted in the population of pediatric patients.^[13]

Provoking binaural beats with a frequency between 200 and 900 Hz has been identified to be exceedingly effective as compared to tones whose frequency exceeds 1000 Hz.^[13] Song et al conducted a study to inspect the efficiency of music on patients subjected to a procedure of biopsy and concluded that music possessed inherent potential to decrease Visual Analog Scale pain scores after biopsy.^[10] Similar correlation can be made to the present study as both music groups brought about reduction in anxiety and hence improved the child's acceptance to treatment.^[10]

In a study where endodontic treatment was performed on the participants, the patients experienced a significant reduction in anxiety after listening to 432 Hz music during their endodontic treatment.^[8] It was also reported that 432 Hz music effectively decreased dental anxiety and signs of vitality (heart rate, systolic and diastolic pressure).^[8] The

current study may be associated with the findings of this study as along with scores of anxiety assessment, there has also been a reduction in pulse rate values after being subjected to the music group for 10 minutes. ^[8]

The effectiveness of the binaural beats in reduction of preoperative dental anxiety in adults (18-40 years) was assessed by Isik et al (2017). ^[11] The study highlighted that binaural beats were unquestionably effective in diminishing dental anxiety. The current research implies that binaural beats has significant anxiolytic effects in children of age 8-12 years. ^[11] The results of the present study are congruous with available literature. ^[11, 12, 13]. The comparison of the two groups showed that both groups were equally potent in reducing anxiety and there was no significant statistical difference between them. The present study demonstrates that both binaural beats and 432 Hz music were efficacious in decreasing dental anxiety.

CONCLUSION

This study revealed that both binaural beats and 432 Hz music were successful in reducing dental anxiety in children. It can be concluded that both music groups are effective aids to relieve anxiety in pediatric patients, with added advantages of being cost effective, easily accessible, and minimal armamentarium. Additional studies may be advocated in order to identify other parameters such as the duration, correlation with different genders or other acceptable frequencies of binaural beats and music therapy during the dental treatment.

CLINICAL SIGNIFICANCE

Within the limitations of the current study setting it may be permissible to conclude that both the groups namely binaural beats and 432Hz music are clinically effective in

reducing anxiety, and its clinical implication points to the fact that music can be a useful aid in reducing dental anxiety in children, particularly during administration of local anesthetic agent.

LIMITATIONS

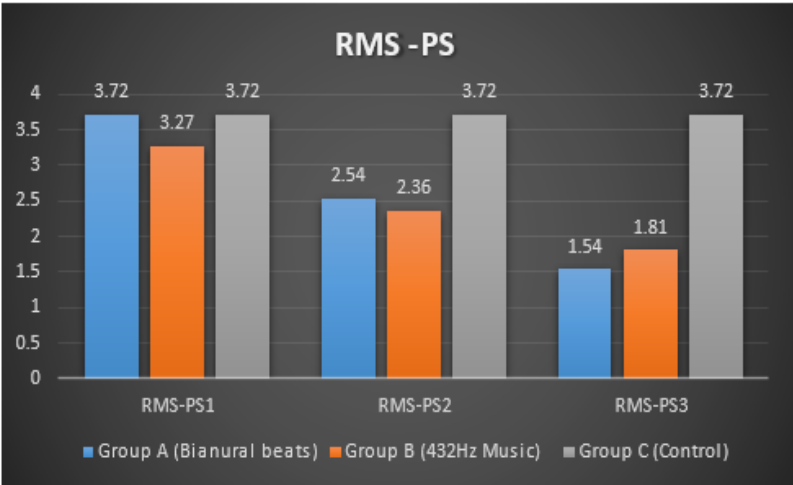
Considerations could have been made to investigate the genders separately. Larger sample size and longer duration is recommended for more accurate clinical results.

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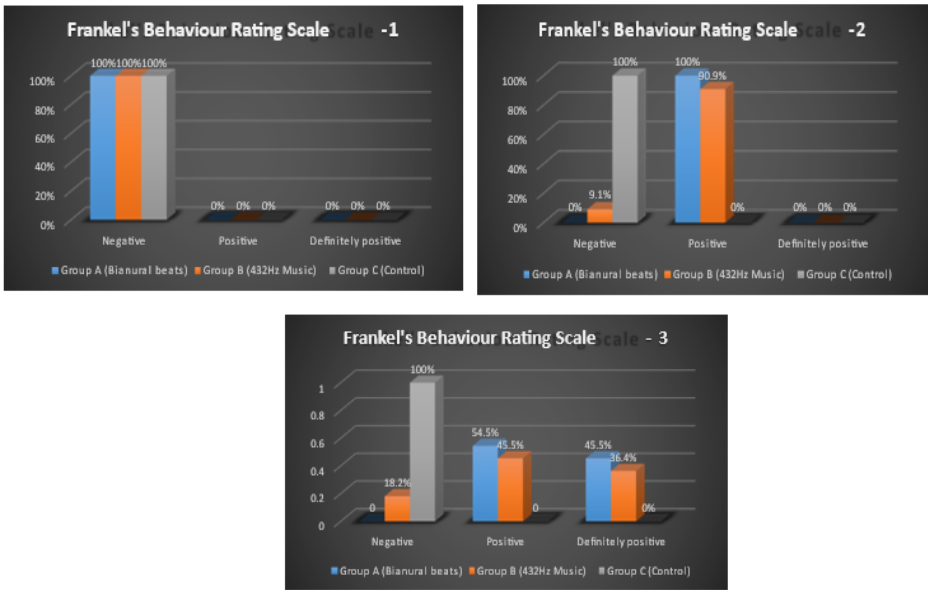
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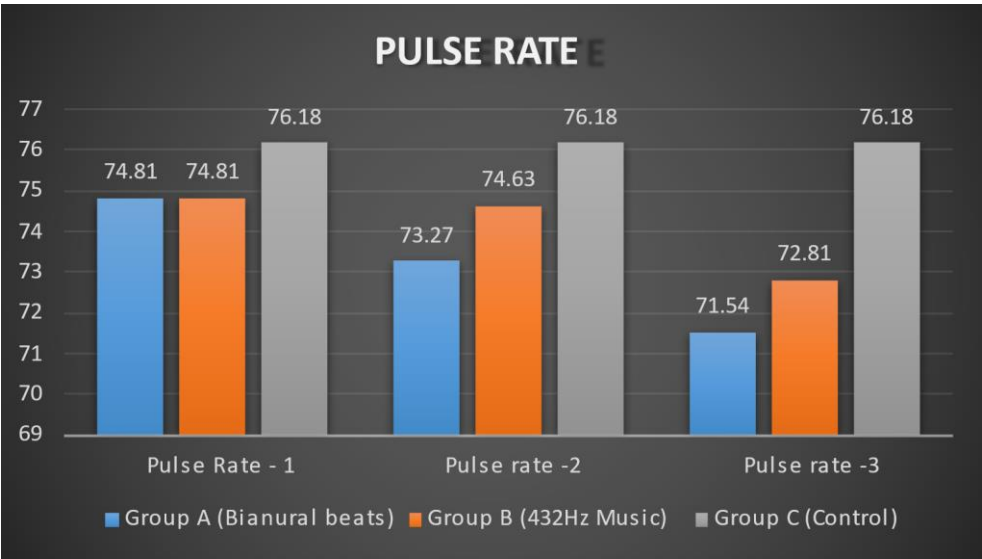
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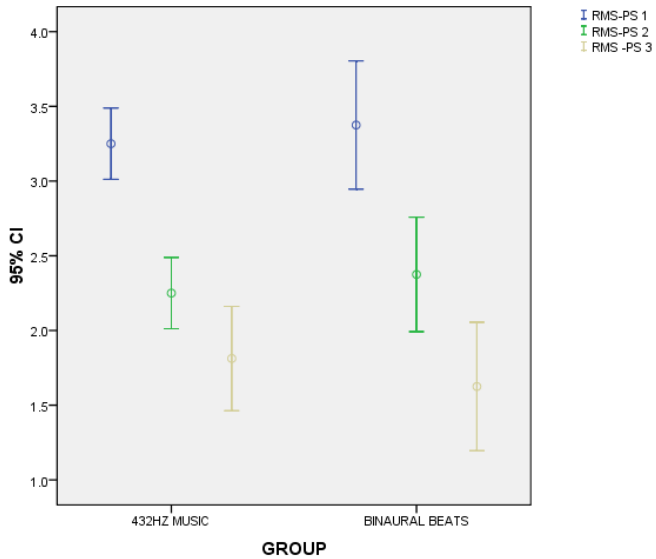
GRAPH 01: Comparison of RMS-PS scores in all three intervals between binaural beats,432Hz music and control group



GRAPH 02,03,04: Comparison of FBR scores in all three intervals between binaural beats,432Hz music and control group.



GRAPH 05: Comparison of pulse rate in all three intervals between binaural beats,432Hz music and control group



GRAPH 06: Error bars for RMS-PS scores in binaural beats and 432Hz music