



The effect of music distraction on pain, anxiety and behavior in pediatric dental patients

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Abstract

Purpose: The purpose of this study was to determine if audio distraction could decrease patient anxiety, pain and disruptive behavior during pediatric dental procedures.

Methods: Forty-five children between the ages of 4 to 6 years had two visits each involving restorative dentistry with local anesthesia in a mandibular quadrant. Visit #1 was a baseline session for all patients. During visit #2, the children were assigned to either an upbeat music group, a relaxing music group or a no music group. Variables measured were: (1) parent-reported anxiety via the Modified Corah Anxiety Scale, (2) self-reported anxiety via the Venham picture scale, (3) heart rate, (4) behavior via the North Carolina Behavior Rating Scale and (5) pain via a visual analogue scale.

Results: No significant differences were found among the three groups during experimental visit #2 across any variables. A majority of patients (90%) stated that they enjoyed the music and would like to listen to it during their next visit.

Conclusions: Audio distraction was not an effective means of reducing anxiety, pain or uncooperative behavior during pediatric restorative dental procedures. However, patients did enjoy listening to the music during their visits. (*Pediatr Dent* 24:114-118, 2002)

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Managing behavior and anxiety so a child can become a cooperative dental patient is critical to the success of treatment. Although traditional behavior management techniques can be successful, the attitudes of parents and some dental professionals toward these techniques are changing. For example, immobilization in a papoose board, although effective, has been shown to be unacceptable among a majority of parents.^{1,2} In addition, many parents feel that pharmacological methods of managing their child are undesirable due to perceived medical risks. For these reasons, clinicians have developed non-aversive behavior management techniques that may be equally effective and more acceptable to parents, patients and practitioners.

Audio distraction is one such non-aversive technique in which patients listen to music or stories during a stressful procedure. Because of its success in medical settings³ and with adult dental patients,⁴ many pediatric dentists and parents believe that this technique can reduce pain and anxiety in pediatric dental patients despite a lack of evidence to support its effectiveness in this setting.

Although the psychological and physiological mechanisms which regulate distraction are not completely understood,⁵⁻⁸ several dental studies have attempted to evaluate the use of audio and video distraction as an adjunct to local anesthesia and other behavior management techniques. Corah and co-workers found that adult dental patients reported reduced pain and anxiety with video distraction and audiotaped relaxation instructions but not with music.^{4,9-11} Studies evaluating pediatric dental patients have found no effect of video distraction on self-reported anxiety during dental treatment.^{12,13} However, some studies have shown a reduction in uncooperative behavior with the use of audiotaped stories.^{14,15} Also, a limited study found a reduction in examiner-reported anxiety when pediatric dental patients were exposed to a short period of music.¹⁶

In contrast to the inconclusive results from pediatric dental studies, health care professions outside dentistry have found audio distraction useful for children undergoing painful or stressful procedures. Patients provided with music before or during the injection of a preoperative medication or immunization exhibited less pain and anxiety-related behavior than a no-music control group.^{17,18}

The questionnaire has been designed to assist my research into dental anxiety in children, and I would appreciate your cooperation in circling the answers that most closely fit your child's attitude.

1. If your child had to go to the dentist tomorrow, how would he feel about it?

- a) He would look forward to it as a reasonably enjoyable experience.
- b) He wouldn't care one way or the other.
- c) He would be a little uneasy about it.
- d) He would be afraid that it would be unpleasant and painful.
- e) He would be frightened of what the dentist might do.

2. When he is waiting in the dentist's office for his turn, how does he feel?

- a) Relaxed
- b) A little uneasy
- c) Tense
- d) Anxious
- e) So anxious that he sometimes breaks out into a sweat, or almost feels physically sick.

3. When he is in the dentist's chair waiting while the dentist gets the drill ready to begin working on his teeth, how does he feel?

- a) Relaxed
- b) A little uneasy
- c) Tense
- d) Anxious
- e) So anxious that he sometimes breaks out into a sweat, or almost feels physically sick.

4. When he is waiting in the dentist's chair to have his teeth cleaned and the dentist is getting the instruments he will use to scrape the teeth around the gums, how does he feel?

- a) Relaxed
- b) A little uneasy
- c) Tense
- d) Anxious
- e) So anxious that he sometimes breaks out into a sweat, or almost feels physically sick.

Patient's Name _____

Date of Birth _____ Sex _____

Score: a=1, b=2, c=3, d=4, e=5

Fig 1. Modified Corah Anxiety Scale Questionnaire

There is a widely held perception that music can reduce the pain and anxiety of pediatric dental patients despite a lack of conclusive results from well-controlled studies. Previous studies have used as subjects children with a mean age of 6 years or older. There is a need to test distraction techniques on a younger age group that may exhibit more disruptive behavior and dental anxiety. In addition, most of these studies did not measure physiological responses which could be indicative of anxiety and pain levels. Also, patients and parenting practices have changed in the 15 years

since the last reported dental studies on children. There is a need to determine how today's children would respond to audio distraction. Therefore, the purpose of this study was to investigate the effects of music distraction on pain, anxiety and behavior in patients 4 to 6 years in age undergoing dental treatment.

Methods

This study was approved by the institutional review board of Columbus Children's Hospital. The sample consisted of 45 children who presented to Children's Hospital Dental Clinic in Columbus, Ohio, for routine care. Eligible patients were healthy 4- to 6-year olds who required restorative dental treatment with local anesthesia on both mandibular quadrants and had demonstrated "positive" to "negative" behavior (Frankl 3 or 2). Parents were encouraged to ask questions before signing a written consent form explaining the study.

The sample was divided into three equal groups: (1) upbeat music distraction, (2) relaxing music distraction and (3) a no music control. The child did not have a choice of music. The upbeat music consisted of age-appropriate folk music songs: *A Child's Celebration of Folk Music* by various artists (Music for little People, 1996). The relaxing music was slow, lulling instrumental music: *In the Enchanted Garden* by Kevin Kern (Real Music, 1996). Groups were matched for age and sex. The patients were assigned to one of the three groups on their first study visit. The same pediatric dentist and dental assistant treated all patients. Behavior management techniques of tell-show-do and voice control were used, if necessary, in a conventional manner. No immobilization was used.

Each visit lasted approximately 30 minutes and consisted of restorative treatment in a mandibular quadrant with local anesthesia via an inferior alveolar nerve block. The parent was not present in the operatory during the treatment. To determine the parent's perception of the patient's anxiety prior to treatment, the parent was asked to complete a Modified Corah Anxiety Scale Questionnaire¹⁹ (Fig 1) while the child was in the dental operatory.

Visit #1 was a baseline session, no audio distraction or headphones were used. After the patient was seated in the dental chair, but prior to treatment, the dental assistant administered the pre-op Venham picture test²⁰ to measure patient-reported anxiety. Baseline heart rate was recorded by pulse oximetry. The dentist then entered the operatory and video recording of the child's behavior began. The child was aware that the dental team was "making a movie" during the visit. Heart rate was recorded at baseline, during topical anesthesia, the injection of local anesthetic and rubber dam placement, and at 5-minute intervals during treatment. After treatment was completed, the dentist left the operatory and video recording was stopped. A post-operative Venham picture test and a visual analogue scale, to measure patient-perceived pain, were administered.

Visit #2 was scheduled approximately 1 to 2 weeks after visit #1. During visit #2, the children in the 2 music groups

Table 1. Self-Reported Anxiety Measurements, Venham Picture Scale

	Upbeat Music	Relaxing Music	No Music	F	Sig
Visit #1					
Pre-op	2.5±2.5	1.6±2.1	1.8±1.9	0.725	0.490
Post-op	1.8±2.3	2.8±3.4	2.0±2.7	0.589	0.560
Visit #2					
Pre-op	2.0±2.6	1.2±1.9	1.6±2.1	0.464	0.632
Post-op	1.6±2.0	2.0±3.0	2.0±2.9	0.109	0.897

One-way ANOVA as a function of groups

were exposed to music through headphones via a portable compact disc player. The children in the control group wore headphones without any music. The Modified Corah Anxiety Scale, Venham picture test and baseline heart rate measure were conducted similar to visit #1. Volume was adjusted to a level where the patient could hear the music as well as the dentist's instructions. Video recording and heart rate measures were similar to visit #1. Only the dental assistant was aware of the patients group assignment. Treatment was completed on the contralateral mandibular quadrant.

As with visit #1, following treatment a post-operative Venham picture test and the visual analogue scale were administered. At the conclusion of visit #2, the dental assistant asked the patients in each of the music groups the following two questions: (1) "Did you enjoy listening to music during your visit?" (2) "Would you like to listen to music at your next visit?"

A research assistant blinded to the group assignments conducted the behavior analysis by computer coding the video recorded visits. The type of behavior during each visit was coded on a computer program that could then calculate the amount of time each behavior was displayed throughout the visit. The research assistant was deemed to be reliable on the North Carolina Behavior Rating Scale²¹ after coding a specific sequence of events consistently at least 5 times. This scale measures specific disruptive behaviors such as crying, movement and resistance.

Results

The study sample consisted of 45 children. There were 21 males and 24 females. The age range was 48 to 83 months with a mean age of 64.7±10 months. There was no significant difference in age among the three groups. (Upbeat music: 65±8 months, relaxing music: 67.7±12 months, no music: 61.5±11 months). Each group had 7 males and 8 females.

Parental perception of patient's anxiety

The Corah scale measured the parents' perceptions of their child's anxiety before the dental appointment. A score of 4 indicates the lowest level of anxiety while a score of 20 indicates the highest possible level of anxiety. The mean Corah score was 7.5 for visit #1 and 7.8 for visit #2. There was no

Table 2. Behavior Rating During Visit #2, North Carolina Behavior Rating Scale

	Upbeat Music	Relaxing Music	No Music	F	Sig
Crying	5.7±10.2	10.8±23.0	4.4±5.8	0.773	0.468
Hand movement	2.1±3.0	7.0±15.0	2.5±5.1	1.289	0.286
Leg movement	0.4±1.3	0.5±0.7	0.4±0.8	0.029	0.972
Oral-phys res	3.1±11.3	0.5±1.6	0.2±0.7	0.867	0.427
Quiet	88.4±20.7	81.0±27.5	92.3±8.4	1.172	0.320

Mean±SD of percent time of visit #2 for each behavior. One-way ANOVA as a function of groups.

significant difference in Corah scores among the 3 groups at either visit #1 or visit #2. There was also no significant difference in the Corah scores between visit #1 and visit #2. Pearson correlations show the Corah score on visit #1 to be moderately correlated with the Corah score on visit #2 ($r=0.59$, $P<0.001$).

Self-reported anxiety measures

The Venham scale was administered 4 times to each patient: prior to each treatment session (Venham pre-1 and pre-2) and immediately following (Venham post-1 and post-2). An analysis of variance was completed analyzing the pre- and post-treatment Venham measurements for the 3 groups. There was no significant difference in self-reported dental anxiety among the 3 groups at visit #1 or visit #2 (Table 1).

There was no statistically significant difference between pre- and post-operative scores in any of the groups. The Venham scores were strongly correlated with each other. There was a strong correlation between the pre-operative measures of visit #1 and visit #2 ($r=0.60$, $P<0.001$). Likewise, there was a similarly strong correlation between the post-operative measures of visit #1 and visit #2 ($r=0.56$, $P<0.001$).

Heart rate

A repeated measures analysis was used to evaluate heart rate at baseline, placement of topical anesthetic, injection of local anesthesia, rubber dam placement, and the first 5 minutes of treatment. A consistent pattern was found for all 3 groups at visit #2. The data showed an increase in heart rate during the injection phase. The heart rate then decreased during rubber dam placement and treatment, but not to the baseline level. No significant difference in heart rate was found among the groups during visit #1 or visit #2.

Behavior measures

The North Carolina Behavior Rating Scale was used to measure disruptive behavior during the treatment sessions. The children exhibited predominantly quiet behavior at both visits. A one-way analysis of variance was used to compare the percentage of time spent quiet or demonstrating each

Table 3. Self-Reported Pain Measurement, Visual Analogue Scale

	Upbeat Music	Relaxing Music	No Music	F	Sig
Visit #1	37.2±4.4	58.5±38.7	28.2±34.0	2.838	0.070
Visit #2	29.4±32.5	28.8±35.7	40.0±41.9	0.436	0.649

One-way ANOVA as a function of groups

type of disruptive behavior among the 3 groups at visit #2 (Table 2). No significant difference in behavior was found among the 3 groups during visit #1 (data not shown) or visit #2.

Self-reported pain measures

A visual analogue scale was used to measure the amount of patient-reported pain experienced during dental treatment on a scale from 1 to 100. The scores varied widely for each visit. An analysis of variance was completed which found no significant difference in pain reported among groups at either visit (Table 3).

Post-operative questions

The music groups were asked 2 questions at the end of visit #2. There was no significant difference in the answers between the 2 groups. When asked if they enjoyed listening to the music, 14/15 (93%) in both groups said, "Yes." When asked if they would like to listen to music at their next visit, 13/15 (87%) in the upbeat music group and 14/15 (93%) in the relaxing music group stated "Yes."

Discussion

Results from this study indicate that audio music distraction did not result in a reduction of pain, anxiety or uncooperative behavior during dental procedures on young patients. These results are consistent with several previous studies which found that distraction with music did not reduce pain or anxiety in dental patients.^{4,9-11} Together, these results suggest that music alone is ineffective as a distraction during dental procedures.

In contrast, our results conflicted with pediatric dental studies showing a reduction in disruptive behavior with the use of audiotaped stories.^{14,15} It is possible that differences in patient pool and methodology contributed to our conflicting results, although, most likely, these contradictory results stem from a difference between distraction with music and distraction with stories. Similarly, our results did not agree with those of Parkin, who found a reduction in anxiety with music distraction.¹⁶

However, there were several significant limitations to this study. Patients were exposed to music for only 5 minutes. They were then evaluated on silent videotape. Blinded raters compared 60 seconds of "with music" to 60 seconds of "without music" for each patient visit on a visual analogue scale. There was no negative control group or baseline measures and the operator was not blinded to the presence of music. The results were also in conflict with studies which

demonstrated a reduction in pain and anxiety prior to medical injections.^{17,18} Again, patient selection and methodology may have contributed to the differences in our results but there are also obvious and substantial differences between a quick immunization and a restorative dental procedure.

In both the Corah scores and Venham measurements, no difference was found between visit #1 and visit #2 for any group. This suggests that the patient's experience in visit #1 did not cause increased anxiety prior to visit #2, confirming visit #1 as a sound baseline. Measurements at visit #2 indicated that the music had no effect on anxiety. It is possible that this pool of patients may not have had a level of anxiety high enough to be affected by the audio distraction. However, it is just this type of patient, Frankl 3 or 2, for which this technique is most routinely indicated.

In addition to psychological measures, a physiological measurement of anxiety was also made by recording heart rate. Since vasoconstrictor or pain can also cause a change in heart rate, it is important to compare heart rates at critical periods in the treatment session such as injection and rubber dam clamp placement. There was no significant difference in heart rate among groups at visits #1 or #2. This provides another indication that music distraction did not have an effect on pediatric dental anxiety.

The visual analogue scale for pain was used to determine the self-reported perception of pain during the dental treatment. Results indicate that music distraction did not have an effect on pain experienced by these pediatric dental patients. This test was the most difficult for the children to comprehend. Since it was administered after the appointment, the child may not have been able to transfer feelings of pain during the appointment to the time when the test was administered. Administering the pain scale at specific intervals during the visit, such as immediately after the injection or after rubber dam placement, may have been more telling.

Although great care was taken to standardize the visit protocol, there was still large variability in the data. This was the case in both the baseline visit #1 and the experimental visit #2 and in patient response data as well as observational data. This variability may have been a result of differing patient temperaments, previous dental or medical experiences or the specific nature of the dental procedures. Despite this variability, there was consistency in the heart rate data and the percent of quiet behavior, which suggests that the conditions of the study were reasonably uniform.

It is possible that, in not allowing a choice of music, the outcome of the study may have been affected. Klein and Winkelstein suggest that playing familiar songs, perhaps music that the patient brings with them, would help the child gain control over an unpleasant situation and feel more familiar with the environment.²² However, 93% of the patients who received music stated that they enjoyed listening to the music.

Since the dentist and assistant needed to communicate with the patient, the volume was set at a level so the patient

could easily hear instructions. Therefore, the music was not loud enough to mask other sounds in the dental operatory which may have been disturbing to the patient (eg high-speed handpiece and suction noise). It is possible that solid headphones, a higher volume and a microphone for communication by the operator may have allowed more complete immersion into the music and therefore, more distraction from the dental procedure.

This study did not show any quantifiable effect of music distraction on pain, anxiety or patient behavior for dental patients 4 to 6 years old. The data contradicts the widely held belief that music can reduce the anxiety of pediatric dental patients. The anxiety of certain procedures, such as intraoral injections, may be too overwhelming to be overridden by audio distraction. Also, children of this age group may not be capable of becoming engaged in music to the level of distraction. However, It remains possible that this technique may be effective in other age groups or when used in conjunction with other non-aversive behavior management techniques.

Conclusions

1. Audio music distraction did not produce a reduction in pain, anxiety or disruptive behavior in young pediatric dental patients.
2. Despite a lack of an effect on pain and anxiety levels, patients had an overwhelmingly positive response to the music and would choose to listen to it at subsequent visits.

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