



Effectiveness of music interventions in reducing dental anxiety in paediatric and adult patients

Submitted by

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A thesis submitted in total fulfilment of the requirements for the degree of

Master of Philosophy

The Joanna Briggs Institute, Faculty of Health Sciences

The University of Adelaide

November 2011

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Abstract

Background Dental anxiety has been identified as a significant and common problem in both children and adults and is considered an obstacle for dental care providers in the delivery of quality oral care. There are various treatment options for reducing dental anxiety and music is one of the treatment options. Music interventions can either be passive (music listening) or active music (therapy).

Objective The objective of this study was to present the best available evidence related to the effectiveness of music interventions on dental anxiety in paediatric and adult patients.

Data sources A comprehensive search was undertaken on major electronic databases from their inception to October 2010. The search was restricted to English language and other languages where a translation was available.

Review methods Randomised controlled trials, quasi-randomised controlled trials and quasi-experimental studies were included in the review. Critical appraisal and data extraction were undertaken using the Joanna Briggs Institute critical appraisal instrument and the standard data extraction form for evidence of effectiveness.

Results Two studies had paediatric patients as population group. One study found that music listening did not result in any reduction of anxiety during dental procedures on young patients. However, another study found that music reduced anxiety to some extent, which was not significant.

Five studies included in this review had adult patients as population group. Two studies concluded that relaxation when compared to music was an effective method of reducing patient's anxiety. One study concluded that music listening significantly lowered levels of anxiety and stress of females during dental procedures. Two other studies provided conclusive evidence on effectiveness of music in reducing dental anxiety in adults.

Conclusions There is enough evidence to suggest that adult patients may benefit from music listening during dental treatment. There is inconclusive evidence on the effectiveness of music in reducing dental anxiety in children.

Implications for practice It is recommended that pre-recorded music be offered through headphones during the dental procedure, particularly in adult patients to reduce their dental anxiety.

Implications for research More research needs to be performed before it is possible to show, with a higher degree of certainty, that music listening does have a significant effect on the reduction of dental anxiety, particularly in children.

Keywords: Music, music therapy, music listening, dental anxiety, adults, children

Statement of Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Sandeep Moola and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Acknowledgements

I wish to sincerely thank Prof Alan Pearson AM for not only supervising my systematic review and thesis, but also for his valuable input, knowledge and wisdom during the course of this research work in the past 18 months.

I wish to thank Dr Zoe Jordan for agreeing to be my associate supervisor for the last few months of my candidature and for reviewing this thesis.

I also wish to thank Dr Christina Hagger, my former co-supervisor for her valuable input during the course of the systematic review and Mrs Maureen Bell, Research Librarian, The University of Adelaide for her help with the search strategy.

Finally, I want to express my appreciation to my wife, Priyanka who has been so patient and supportive during this whole process.

Chapter 1: Introduction

1.1 Dental anxiety

Dental anxiety has been identified as a significant and common problem in both children and adults and is considered an obstacle in the provision of quality dental care by dental care providers. It is reported that one in six adults suffer from some form of dental anxiety¹ and in children the prevalence ranges between 5.7% and 19.5%². Patients with dental anxiety tend to neglect dental care which poses a problem for both dentists and patients.¹ According to Eli, a dentist-patient relationship that is dominated by severe patient anxiety may lead to misdiagnosis and inappropriate treatment.³

Spielberger defined anxiety as “an emotional state consisting of feelings of tension, apprehension, nervousness and worry, with activation of the autonomic nervous system”.⁴ Dental anxiety is defined as “an abnormal fear or dread of visiting the dentist for preventive care or therapy and unwarranted anxiety over dental procedures”.⁵ Dental anxiety (DA) is associated with a state of apprehension with a fear of something dreadful is going to happen during dental treatment.² Dental anxiety has long been recognised as a source of serious problem in providing dental services to patients.⁶ The development and emergence of different degrees of dental anxiety is said to be influenced by role model learning and stories told by people in everyday surroundings.⁷ Terms such as dental fear, dental phobia, and dental anxiety are often used synonymously and do not have universally agreed definitions with no clear-cut clinical boundaries.

1.2 Prevalence of dental anxiety

Advances in dental treatment methods and technology and increased knowledge, did not have any impact on the reduction of dental anxiety over the past few decades as shown by various studies conducted in several countries across a wide range of cultures.⁸ Bernson et al found that 4–20% of adults report high dental anxiety and that 2–3% show phobic avoidance or report irregular dental care.⁸ The prevalence of dental anxiety ranges between 2.6% to 20.4% in the U.S. population.⁹

Published data from 1996 in Australia showed that 14.9% adults could be classified as highly dentally anxious.¹⁰ One survey found that nearly two thirds of dentists believed that treating an anxious patient presented a challenge to them in everyday practice.¹¹ Primary research studies have reported that the prevalence of high levels of dental anxiety ranges between 4 percent^{12, 13} and 20 percent.^{12,14} In a survey conducted in England in 5 year old children with dental anxiety, it was found that there were statistically significant higher rates of carious teeth.¹⁵

The reported dental anxiety prevalence across various studies shows that it is a significant problem for both dental health care workers and patients. It is reported that anxious patients “require more chair time, frequently cancel scheduled appointments and are regarded by dentists as a great source of professional stress”, which have an impact on additional costs for patients as well.⁹ Studies showed that when compared to dentally relaxed patients, dentally anxious patients often avoid dental visits for long periods or avoid dental services all together.^{16,17}

Hmud et al stated that the prevalence of dental anxiety reduces with age; however, they also found that few other studies do not show a strong association of dental anxiety with age.¹ In addition, the relationship between dental anxiety and other demographic variables such as income level and education (socioeconomic status) is not clear.

Studies suggest that gender and age are important factors associated with dental anxiety. One study found that females aged between 30-45 years were particularly dentally anxious¹⁰ while another found a high prevalence of dental anxiety in girls when compared to boys¹⁸. However, some studies showed no difference in dental anxiety between the genders.¹⁹ Armfield, in his study reported that females have a greater prevalence of fear and more extreme fear than do males.²⁰

1.3 Consequences of dental anxiety

It has been reported that dental anxiety is associated with increased levels of caries and behavioural management problems in children.¹¹ In addition, patients with dental anxiety are found to have poorer oral function and oral aesthetics.²¹ Fear of dental treatment is also recognised as a serious public health concern.²² A Finnish study reported that 15% of the children did not seek care because of fear of dental treatment.²² In a study conducted in the US, the reported prevalence was 43% with low to moderate general dental fear and 10% with high dental fear.²³

Bray et al stated that avoiding preventive dental care appointments such as dental checkups may lead to severe disease situations requiring more invasive dental procedures which will further lead to increased anxiety of the patient.⁹ It has also been reported that anxious patients tend to have poorer oral function and aesthetics with an increased number of decayed and missing teeth.²¹ In addition; dentally anxious patients when compared to non-anxious patients have significantly more missing teeth and fewer filled teeth.²⁴

Dental anxiety leading to avoidance of dental treatment is common and is strongly associated with clinically significant deterioration of oral and dental health^{7,25} that in turn leads to “a vicious cycle of cumulative anxiety and increasing avoidance”.²⁰ It often means a higher probability of irregular dental attendance with only emergency dental treatments or even sometimes total avoidance which leads to the deterioration of oral health as well as associated feelings of anxiety, shame and inferiority.^{1,20} In addition, anxiety during dental treatment was found to prevent the patient from cooperating fully with the

dentist resulting in loss of time for the dental professional, unnecessary difficulty in performing dental procedures and unsatisfactory results.²⁶ Dental anxiety is also considered as a potential predictor of dental caries incidence.²⁷

1.4 Causes of dental anxiety

Bare and Dundes in their research identified several factors associated with patients' reporting of dental pain and anxiety: 1) patients' painful experiences; 2) belief that painful treatment is inevitable; 3) if patients feel that they lack control over the situation, including the inability to stop a procedure they find unpleasant; 4) lack of understanding regarding the procedures that the dentist performs or harbor a general fear of the unknown 5) prior experience with exposure to frightening portrayals of dentists in the media or conveyed by acquaintances' recounting of unpleasant experiences; 6) prior experience of detached treatment by a dentist and/ or a sense of depersonalisation; and 7) fears of experiencing ridicule because of how they react to situations arising during their visit.²⁸

Several studies report that pain or fear of pain is a primary source of anxiety, as well as a major obstacle to seeking dental care.²⁹ In addition, highly anxious patients appear to be more sensitive to pain.^{30,31} Dental injection including the sight and sensation of the anaesthetic needle was found to be the most powerful anxiety-provoking stimulus, followed by the dental drill.³² The period of time spent waiting for the dental treatment in the waiting room has often been cited as a common reason for dental anxiety as it increases the time to ponder about the treatment and its outcomes.³³

It is often reported in the literature that patients associate the dental office as "an unfriendly, and anxiety-provoking environment, characterised by loud noises, distinctive odours, invasive contact in the mouth, and the probability of pain".²⁷ Several primary research studies have shown that restorative dentistry procedures deliver the most potent triggers for dental anxiety, namely the sight, sound and vibrational sensation of rotary dental drills^{33, 34, 35} coupled with the sight and sensation of a dental local anaesthetic injection.^{17,33, 34}

1.5 Treatment of dental anxiety

Treatment of dental anxiety and choosing the right method of managing this disorder is not always easy.¹⁴ A cooperative dental patient is critical to the success of treatment, hence it is essential for a dentist to manage a patient's anxiety, particularly a child's anxiety.³⁶ Therefore, it is important that the dental care providers recognise the need to develop the skill of assessing patients' behaviour, the reasons for their problems and identifying suitable methods of treatment.

Effective treatment options include an explanation of the treatment procedure,³⁷ pharmacological strategies involving the use of benzodiazepines and antidepressants,³⁸ biofeedback,³⁹ hypnosis⁴⁰ and behavioural interventions^{41,7}. Behavioural management was found to be superior to anxiolytic drug therapy,⁴² and dentally anxious patients reported that they prefer nonpharmacological interventions^{43,7}. Most of the behaviourally oriented treatments included components based on systematic desensitisation⁴¹ and use of relaxation to counteract and weaken the fear response during gradual exposure to treatment.⁷ Relaxation and breathing techniques have been successful in reducing dental anxiety in patients.⁴⁴ Medications provide only short term cost effective solutions; but there are few long term benefits with a greater rate of relapse, and an increased patient risk due to the potential for serious drug interactions or overdose.⁹

1.6 Music

Music offers an alternate treatment option which has been used in different medical fields to meet physiological, psychological, and spiritual needs of patients. Research on the effects of music and music therapy for medical patients has increased during the past 20 years and has included a variety of outcome measures in a wide range of specialty areas.⁴⁵ Specifically, the anxiolytic effects of music have been studied in a variety of medical patients, including surgical,⁴⁶ cardiac,⁴⁷ and oncology patients⁴⁸.

Suitable music has been shown to have a strong influence on human brain waves, which leads people into states of deep relaxation.⁴⁹ It is known that music and medicine have been closely associated for centuries and the concept of music therapy has evolved over the centuries, where today music is acknowledged as a therapeutic modality and scientific evidence attesting to its psychological and physiological beneficial effects.⁵⁰

Music is the “art of arranging sounds in time so as to produce a continuous, unified, and evocative composition, as through melody, harmony, rhythm, and timbre”.⁵¹ Music has many relaxation benefits and can have a positive influence on the patient by making concentration easier and easing anxiety.⁴⁹ The advantage with music is it not only helps in relaxing during treatment or surgery, it is also a popular daily stimulus for many people.⁵² There are different types of music (e.g., folk, contemporary, classical, lullaby). Music theorists including Bonny⁵³, Gfeller⁵⁴ and Guzzetta⁵⁵ stated that music has the ability to distract and divert attention away from stressful stimuli, promote feelings of physical and mental relaxation by refocusing attention on to pleasurable emotional states and block unpleasant environmental sounds.

1.7 Music therapy and music listening

There is a distinction between music interventions administered by medical or healthcare professionals (passive music listening) and those implemented by trained music therapists (active music therapy). Active music therapy is “the planned and creative use of music by a music therapist to attain and maintain health and wellbeing”.⁵⁶ People of any age or ability may benefit from a music therapy programme regardless of musical skill or background.⁵⁶ Passive music listening is the passive listening to pre-recorded music offered by healthcare professionals without the involvement of music therapist.⁵⁷

The term music listening is often used inconsistently as it is often referred to throughout the literature as its umbrella term ‘music therapy’.⁵⁸ Bruscia described music listening as “the ‘receptive’ type of music experience whereby the client listens to music and responds to the experience silently, verbally, or in

another modality”.⁵⁹ Gillen states that this music experience coupled with other music types “such as recreating/performing or composing music, are all distinct music experiences with their own therapeutic potentials and applications, forming part of the whole therapeutic approach of ‘music therapy’”.⁵⁸

According to Munro & Mount, music therapy is defined as “the controlled use of music, its elements and their influences on a human being to aid in the physiological, psychological and emotional integration of the individual during the treatment of an illness or disability”.⁶⁰ Music therapy is also defined as a “scientific functional application of music by a therapist who is seeking specific changes in an individual’s behaviour”.⁶¹ Cook, in her paper stated that dentists were one of the leading proponents of music, using it to promote relaxation and pain control in their patients.⁶²

Studies indicate that active music therapy interventions with medical populations are statistically significantly more effective than passive music listening interventions, for a wide variety of outcomes.^{45,63} This difference might be attributed to the fact that music therapists individualise their interventions to meet patients' specific needs, more actively engage the patients in the music making, and employ a systematic therapeutic process that includes assessment, treatment, and evaluation.⁴⁵

1.8 Music and its effects

Studies have reported that music intervention decreases surgical stress, induces relaxation, decreases blood pressure (BP), heart rate (HR) and respiratory rate (RR) during an operation in local anaesthesia in medical populations.⁶⁴ It is also essential that for musical intervention to be effective in decreasing anxiety levels, the type of music, volume of the music and patient’s choice of music should be considered.^{65,66}

The anxiolytic effect of music listening is a result of its ability to provoke changes in automated and central nervous functions, which have a positive impact on physiological responses.⁶⁷ Music promotes relaxation by acting as a stimulus and distracting and diverting feelings of anxiety, stress and fear.⁶⁸

In surgical patients, music therapy was found to be a noninvasive, inexpensive, and an effective means of controlling perioperative anxiety levels in patients.⁶⁴ Musical intervention was found to be associated with decreased blood pressure (BP) in patients undergoing local anaesthesia.⁶⁹ In addition, it was found that music therapy induced relaxation, decreased BP and normalised arrhythmias during an operation with local anaesthesia.⁷⁰

1.9 Measuring dental anxiety

Several measures and scales have been developed to classify dentally anxious patients and to assess their level of anxiety for prevalence, aetiology and treatment studies. Rating scales are some of the more consistently measures in dental settings and they have been used quite effectively.

Frankl, Shiere, and Fogels in 1962 developed a scale, now known as Frankl scale.⁷¹ Frankl scale contains four categories of behaviour that range from definitely positive to definitely negative.⁷¹ It is reported that the use of dichotomous ratings with this scale restricts the range of scores available for statistical analysis and results in use of statistics that are less sensitive when compared with continuous ratings.⁷² Frankl Scale is found to have a high reliability; however, the ratings made on the basis of Frankl's categories are found to not correlate highly with other measures of dental anxiety, such as self-ratings.⁷²

Venham, one of the most prolific researchers in the field of child development and behaviour constructed two rating scales; a scale of anxiety and a scale of behaviour.⁷² Ratings are made during three periods within a visit, and responses are averaged for the entire visit.⁷³ Measurements are made on three occasions during the visit and then a mean is taken of the three outcomes, which provides a measurement of the anxiety level in the whole appointment.⁷³

Self-reporting scales measure patient's or parent's (of a child) responses in evaluating the level of anxiety. They are widely used as they are quick and easy to employ but the validity for some of these

scales is questionable. The Dental Anxiety Scale (DAS) includes four questions intended to measure the level of anxiety.⁷⁴ The validity and reliability is acceptable. Wong and his colleague modified DAS into the Modified Dental Anxiety Scale (MDAS).⁷⁵ The scale consists of eight questions related to different dental procedures and uses a 'five points' scale to assess the level of anxiety ranging from relaxed to very worried.⁷⁵

Physiological responses to anxiety during dental appointments include increased blood pressure, heart rate, skin temperature and respiration rate. Heart rate has been a useful measure in assessing the level of anxiety in dental settings.⁷⁶ Physiological responses have been reported as indicators of anxiety and pain levels.³⁶ Music helps to alleviate anxiety because of its effects on the nervous and immune systems. Literature suggests that the effectiveness of music can be demonstrated through the use of radial immunodiffusion (a laboratory technique used to determine the concentration of an immunoglobulin) by measuring the antibody known as Secretory Immunoglobulin A (S-IgA), which is considered a marker of stress in patients undergoing stressful dental operation.⁶³

1.10 Gap in the literature

It has been reported that dentists, parents and patients believe that music may reduce dental anxiety despite a lack of conclusive evidence of its effectiveness.^{6,36} Music is believed to reduce dental anxiety by either having a relaxing or distracting effect (or both) that in turn reduces the activity of the neuroendocrine and sympathetic nervous systems.⁷⁷

There is a significant gap in the literature on the effectiveness of music therapy and music listening in reducing dental anxiety in patients undergoing various dental treatments/procedures. The advantages of relieving dental anxiety in children and adults could include fewer dental avoidances, improved oral health care and attitudes as well as improved oral health outcomes. Therefore the systematic review⁷⁸ looked at the effectiveness of music interventions in reducing dental anxiety in paediatric and adult patients.

Chapter 2: The Systematic Review Protocol

2.1 Review Objective

The objective of this study was to critically appraise, synthesise and present the best available evidence related to the effectiveness of music interventions on dental anxiety in paediatric and adult patients.

2.2 Review Question

What is the effectiveness of music interventions on dental anxiety in paediatric and adult patients?

2.3 Criteria for considering studies for this review

2.3.1 Types of Studies

The systematic review included randomised controlled trials (RCTs), quasi-randomised trials and quasi-experimental studies.

2.3.2 Types of Participants

Paediatric (1 year old to 16 years old) and adult patients (including older adults, 18 years old to 80 years old) undergoing dental treatment in dental clinics and hospitals. People with any pre-existing conditions that could have confounded findings (e.g. deaf patients, special needs patients) were excluded.

2.3.3 Types of Interventions

The interventions of interest were active music therapy and passive music listening throughout the dental procedure. The former involves a music therapist and interactive communication; the latter involves listening to music or passive listening to pre-recorded music offered by dental personnel. The type of music may vary (e.g., folk, contemporary, classical, lullaby).

Studies including a combination of interventions where the direct effect of the music intervention cannot be determined (for e.g. relaxation therapy combined with music or pharmacological therapy with music) were excluded.

2.3.4 Comparators

Comparators included talking, placebo (headphones without music), relaxation techniques (such as progressive muscular relaxation, paced breathing etc) and pharmacological techniques (such as sedation with nitrous oxide and other anxiolytic drugs like diazepam, midazolam etc).

2.3.5 Types of Outcome Measures

The primary outcome of interest was dental anxiety, assessed with a variety of self-reported questionnaires, rating scales and physiological measures.

2.4 Review Methods

2.4.1 Search strategy

A three-step search strategy was undertaken. Search strategy and search histories from some of the major databases are included (Appendix 3). The search strategy aimed to find both published and unpublished studies in English language and other languages where a translation was available from colleagues (for e.g. Chinese, Japanese, and Italian).

Step one: consisted of a limited search of Medline using the terms music, music therapy, music listening, children, paediatric, adults, patients, dental anxiety, dental procedures, randomised controlled trials. Papers identified through this search were scanned for further key terms that were used in step two to identify relevant key words that could be tested in each subsequent database.

Step two: consisted of a full search of all databases using all the key words identified.

Step three: consisted of the review of reference lists of all included papers for further references and a search of the grey literature for unpublished studies.

Subject librarian expertise was utilised to determine an appropriate search strategy. Experts in relevant fields were contacted for assistance in identifying relevant studies. This included contacting them by email.

There was no time limit on the search period and all the databases were searched from their inception until October 2010. The databases searched included:

- Cochrane Central Register of Controlled Trials
- Cochrane Oral Health Group Database
- CINHAL
- Embase
- ERIC
- Medline
- Web of Science
- SCOPUS

The search for unpublished studies included:

- Google Scholar
- Index to Theses
- Directory of Open Access journals
- Networked Digital Library of Theses
- Mednar

Electronic searching resulted in lists of articles with details of title, author, source, and an abstract. All identified articles were assessed on the basis of the abstract (or title if abstract not available), and full reports were retrieved for all studies that met the inclusion criteria for the review. Full text of the article

was retrieved when there was more information needed to decide on the quality and relevance of the article.

Internet sites of relevant associations were searched:

- American Music Therapy Association: <http://www.musictherapy.org>
- Canadian Association for Music Therapy: <http://www.musictherapy.ca>
- British Society for Music Therapy: <http://www.bsmt.org>
- European Music Therapy Confederation: <http://www.musictherapyworld.de>
- Australian Music Therapy Association: <http://www.austmta.org.au/>

2.4.2 Assessment of Methodological Quality

Two independent reviewers assessed the methodological validity of papers selected for retrieval prior to inclusion in the review using the standardised critical appraisal instruments from the JBI-SUMARI (Joanna Briggs Institute Systems for the Unified Management, Assessment and Review of Information package) (Appendix 1). Any disagreements that arose between the reviewers were resolved through discussion and it was not necessary to bring in a third reviewer to resolve.

Factors that were considered for appraisal of randomised controlled trials included method of generation of randomisation sequence, allocation concealment, blinding, baseline comparability, and dropout rate and whether intention to treat analysis was used in the presence of loss to follow up.

2.4.3 Data Extraction

Data was extracted from papers included in the review using standardised data extraction tools from the JBI-SUMARI and disagreements were resolved through discussion (Appendix 2). Data extracted included:

- Study details – study design, setting and sample size
- Patient characteristics – age, gender, type of dental procedure/dental treatment
- Interventions – music therapy and music listening

- Comparators – talking, placebo (headphones without music), relaxation techniques (and pharmacological techniques)
- Outcomes – dental anxiety, assessed with a variety of self-reported questionnaires, rating scales and physiological measures
- Study quality
- Statistical data

2.4.4 Data Synthesis

RCTs were assessed for appropriateness for synthesis in a meta-analysis using the Joanna Briggs Institute SUMARI software and the Cochrane Collaboration Review Manager software. As there were no comparable RCTs found for this review, and as the data were unable to be statistically combined, the data extracted from the included studies were synthesised into a narrative summary. The studies included were clinically diverse, in that different studies had multiple intervention arms, different outcome measurement scales and different population groups (clinical heterogeneity).

Meta-analysis or statistical pooling was not possible because of the variability in the types of dental treatments performed, intervention groups, group design, the music utilised, the length of intervention and outcome measurement scales utilised. Furthermore, some studies did not provide complete data, results were presented graphically or the style of reporting had the potential for misinterpretation.

Chapter 3: Results

3.1 Description of studies

440 potentially relevant papers were identified in databases searches. 174 duplicate papers were removed. Title and abstract were examined for 266 papers. 34 full text papers were retrieved for comprehensive examination. Twenty-six papers were excluded after full text examination. Eight studies were selected for critical appraisal and one study was excluded after critical appraisal. A flow chart has been included to reflect the study selection process (Figure 1). On final assessment, seven studies were identified as fulfilling all of the criteria for inclusion. A table was developed outlining the characteristics of the included studies and the interventions and outcomes described in each is included as Appendix 4. Two out of the seven studies were RCTs, four quasi-randomised and one quasi-experimental study.

A total of 598 patients underwent different dental procedures/treatments. Six studies were identified for background and discussion. One study did not fulfil the criteria for inclusion and the reason for exclusion is given in the table of “Excluded studies – reasons for exclusion” (Appendix 5). A secondary search was also done by examining the references cited list of each article that remained at the full-article stage. No articles reviewed at this time were included in the review.

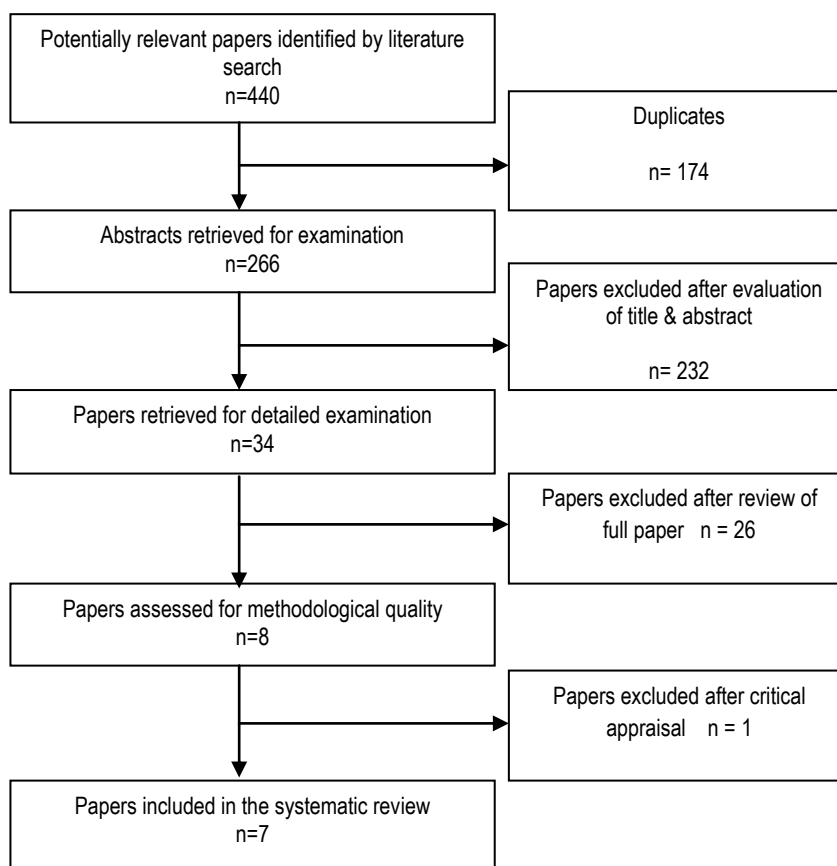


Figure 1: Search results and study selection

It is interesting to note that music listening through headphones was the intervention of choice in all the included studies. The search could not find any studies that included music therapy as an intervention for dental anxiety. The included studies were published between 1981 and 2010 with five studies published after 2001. Three studies were from the USA^{6, 36, 63} and one each from Germany⁷, Korea⁶⁴, Taiwan⁷⁷ and India⁷⁹. Studies were assessed as meeting the criteria for methodological quality if they demonstrated that the intervention and control groups were comparable at entry, received the same treatment other than the intervention and used the same outcome measures.

3.2 Methodological quality

Two out of the seven studies were RCTs^{7, 77}, four quasi-randomised^{6,63,64,79} and one quasi-experimental study³⁶. Four studies that claimed to be randomised failed to report the method of random allocation, hence these studies were considered as quasi-randomised studies. The approaches used by studies reporting method of randomisation were: random number table used for block random assignment⁷⁷ and electronic spread sheet of random numbers⁷. Only two studies attempted to determine sample size by using power analysis^{7, 77}

The number of groups used varied between studies with some having a two-group design^{64, 77}, some three^{7, 36, 79} and others four^{6, 63}. In the two studies that utilised a two-group design, the control group varied in their activities during the intervention period with one study playing a CD of silence⁷⁷ and one study did not specify the type of care⁶⁴. In the three studies that utilised a three-group design two studies had a control group using headphones without any music^{7,36}; one study had a control group with no treatment for dental anxiety and another study did not provide any specific information about the control group⁷⁹. In the two studies that utilised a four-group design one study had a control group with no treatment for dental anxiety, with just a local anaesthetic specified⁶³ and another study did not provide any specific information about the control group⁶.

3.3 Systematic review findings

The results of this review are discussed according to two different population groups: paediatric and adult patients. The findings within the population groups have been presented based on the intervention groups within individual studies.

3.3.1 Paediatric patients

Upbeat music distraction vs relaxing music distraction vs no music control³⁶

A quasi experimental study investigated the effects of music distraction on anxiety and behavior in 45 patients (21 males and 24 females) 4 to 6 years of age who underwent restorative dental treatment with local anaesthesia (via inferior alveolar nerve block) on both mandibular quadrants presented to Children's Hospital Dental Clinic in Columbus, Ohio (USA). The type of restorative dental treatment was not specified.

Patients were divided into three equal groups: upbeat music distraction, relaxing music distraction and no music as control group. The upbeat music consisted of age-appropriate folk music songs (*A Child's Celebration of Folk Music* by various artists, 1996). The relaxing music was slow, lulling instrumental music (*In the Enchanted Garden* by Kevin Kern, 1996). Behaviour management techniques of tell-show-do and voice control were used, if necessary, in a conventional manner.

Patients were matched for age and sex and assigned to one of the three groups on their first visit. The same paediatric dentist and dental assistant treated all patients. Each visit lasted for approximately 30 minutes. Parents were not present in the operatory during the treatment.

The outcomes measured were parent's perception of the patient's anxiety prior to treatment where the parent was asked to complete a Modified Corah Anxiety Scale Questionnaire while the child was in the dental operatory. Visit 1 was a baseline session, where no music distraction or headphones were used. The dental assistant prior to treatment administered the pre-operative Venham picture test to measure patient-reported anxiety. Baseline heart rate was measured by pulse oximetry.

Visit 2 was scheduled approximately 1 to 2 weeks after visit 1. Children in the two music groups were exposed to music through headphones via a portable compact disc player and the children in the control group wore headphones without any music. Similar outcome measurement scales were used as

in visit 1. There was no significant difference in baseline characteristics of patients among the three groups. Each group had 7 males and 8 females.

Effects of the intervention/s

Parental perception of patient's anxiety

Anxiety, as determined by the mean Corah score was 7.5 for visit 1 and 7.8 for visit 2 (a score of 4 indicates the lowest level of anxiety while a score of 20 indicates the highest possible level of anxiety).

There was no significant difference in Corah scores at either visit 1 or visit 2 among the three groups. In addition, there was no significant difference in the Corah scores between visit 1 and visit 2. Pearson correlation showed that the Corah score on visit 1 was moderately correlated with the Corah score on visit 2 ($r=0.59$, $p<0.001$).

Self-reported anxiety measures

The Venham scale was administered four times to each patient prior to each treatment session (pre-1 and pre-2) and immediately following (post-1 and post-2). Analysis of variance (ANOVA) was the statistical method used. Venham measurements showed that there was no significant difference in self-reported anxiety among the three groups at visit 1 or visit 2. In addition, there was no statistically significant difference between pre- and post-operative scores in any of the groups. There was a strong correlation between the preoperative measures of visit 1 and visit 2 ($r=0.60$, $p<0.001$). Similarly there was a strong correlation between the postoperative measures of visit 1 and visit 2 ($r=0.56$, $p<0.001$).

Table 1 Self-reported anxiety measurements, Venham picture scale (one-way ANOVA)

	Upbeat Music	Relaxing Music	No Music	F	P value
<i>Visit 1</i>					
Preop	2.5 ± 2.5	1.6 ± 2.1	1.8 ± 1.9	0.725	0.490
Postop	1.8 ± 2.3	2.8 ± 3.4	2.0 ± 2.7	0.589	0.560
<i>Visit 2</i>					
Preop	2.0 ± 2.6	1.2 ± 1.9	1.6 ± 2.1	0.464	0.632
Postop	1.6 ± 2.0	2.0 ± 3.0	2.0 ± 2.9	0.109	0.897

Physiological parameter - Heart rate

A repeated measures analysis was used to evaluate heart rate at baseline. All the three groups showed a consistent pattern at visit 2. There was an increase in heart rate during the injection phase, which then decreased during the rubber dam placement and treatment, but not to the baseline level. There was no significant difference among the three groups during visit 1 or visit 2.

Instrumental music vs nursery rhymes vs control⁷⁹

This quasi randomised controlled trial investigated the effect of music distraction in managing anxious paediatric patients and in addition compared two different types of music to ascertain the type of music most helpful for reduction of anxiety. Forty children aged between 4 and 8 years with no previous dental experience were recruited for the study conducted in India.

Each child had four dental visits, the first one being a screening visit followed by three treatment visits. The screening visit was to establish the baseline characteristics and values of all the parameters for the patient. The second visit included cavity preparation followed by restorative treatment, and the third visit and the fourth visit included extraction of the decayed teeth.

Children were randomly divided into two groups initially: control group (group A) and music group. Music group was further equally divided two groups: instrumental music group (group B) and nursery rhymes music group (group C). Patients chose their music type and listened to the music through headphones throughout the treatment during all the visits.

Patient anxiety level in each visit was assessed by a combination of four measures, which included Venham's picture test, Venham's anxiety rating scale, pulse rate and oxygen saturation. Pulse rate and oxygen saturation were measured using pulse oximeter. ANOVA was the statistical method used.

Effects of the intervention/s

Venham's picture test measured self-reported anxiety and was administered preoperatively and postoperatively. There was no significant difference between the three groups but there was a strong correlation in Venham's scores in each group during different visits.

Venham's anxiety rating scale measured anxiety during all the visits and reported a significant difference ($p < 0.05$) between the anxiety ratings among instrumental music group and nursery rhyme group, with anxiety being more in the later group.

The control group showed higher mean pulse rate compared to both the music groups; however the differences were not statistically significant. There was a statistically significant difference between the mean pulse rate of the instrumental music group and nursery rhyme group, with anxiety being more in the later. There was no statistically significant difference in values of oxygen saturation during all visits for all the groups.

Table 2 Anxiety measurements (ANOVA)

	Venham's anxiety scale	Pulse rate	Oxygen saturation
Group A	1.1 ± 0.6	105.6 ± 5.6	97.7 ± 2.4
Group B	1.0 ± 0.3	102.6 ± 2.4	98.6 ± 2.6
Group C	1.4 ± 0.7	104.8 ± 3.8	97.2 ± 2.6
A vs B	P = 0.46, NS	P = 0.11, NS	P = 0.16, NS
A vs C	P = 0.14, NS	P = 0.60, NS	P = 0.34, NS
B vs C	P < 0.05, S	P < 0.05, S	P = 0.14, NS

NS = not statistically significant

3.3.2 Adult patients

Relaxation vs music vs music with volume control vs control⁶

Eighty college students (40 men and 40 women) who required a minimum of class II amalgam restorations were recruited for this quasi randomised controlled trial. The setting was a dental emergency school clinic in the USA. A simple dental procedure was carried out on all patients and at the end of the procedure patients were asked to several self-rating scales related to his or her feelings during the dental procedure.

All patients were randomly assigned to one of the four groups at their second visit. The groups included relaxation, music, music with volume control (second music group) and control group (treatment not specified). All patients were again asked to rate themselves on three self-rating scales and completed the dental anxiety scale. Relaxation involved presentation of tape-recorded relaxation instructions through ear phones worn by the patient. Music intervention included recorded music through earphones

throughout the dental procedure and patient had a choice of eight musical programs ranging from classical to popular. Patients had the option to set the volume in the third group (second music group).

All the four groups had no significant differences for all the variables investigated before the introduction of experimental procedures. There were two analyses: comparison of intervention group with the control group and change in response from the first to second visit.

Effects of the intervention/s

Values on the dental anxiety scale (score of 4 indicates low level of anxiety and score of 20 indicates high level of anxiety) were analysed in a group-by-anxiety-by-visit analysis of variance. There was a significant difference between the visits for control and relaxation groups when each group was tested individually. The decrease in anxiety was not significant for both the music groups. In the group-by-anxiety-by-visit analysis, the results indicated that only the high-anxiety control group (mean difference, 1.5) and the high-anxiety relaxation group (mean difference, 2.4) showed significant ($P < 0.01$) decreases in rated discomfort to the second visit. A repeated measures analysis of relaxation and distraction measures by groups showed that there were significant differences in the relaxation group and the second music group.

Table 3 Summary of the major statistically significant results

Measure	Source	F ratio	df	P
Dental anxiety scale	Visit	20.90	1/72	0.001
Patient discomfort rating	Visit	11.52	1/64	0.005
	Group × visit	2.90	3/64	0.05
	Anxiety × visit	5.78	1/64	0.02
	Group × anxiety × visit	2.91	3/64	0.05

Table 4 Mean differences between visits 1 and 2 for the rating measures

Measure	Control	Relaxation	Music 1	Music 2 (with volume control)
Dental anxiety	1.75*	1.95*	1.15	0.65
Patient discomfort rating	0.90	1.30*	0.15	0.05

* $P < 0.01$

Music vs nitrous oxide/oxygen⁶³

A quasi randomised controlled trial investigated the effects of music on reducing patient's fear and anxiety; specifically to find out if there were any significant differences in the levels of S-IgA between music and nitrous oxide interventions. Eighty male and female patients (between 18 and 65 years of age), all patients of the senior author⁶³ were recruited in the author's private dental practice in Utah (USA). All patients were randomly assigned in one of eight categories: local anaesthetic only (male and female, a & b), local anaesthetic plus music (male and female, c & d), local anaesthetic plus nitrous oxide/oxygen (male and female, e & f) and local anaesthetic plus music, plus nitrous oxide/oxygen (male and female, g & h). The dental treatment for all patients was preparation of a tooth for the manufacture and subsequent cementing of a crown.

Patients in the music group had a choice of five different types of music (classical, Broadway hits, new age, country and western and light contemporary hits). Prior to the dental treatment, 5 microlitres of saliva were extracted from all patients with a Samco Transfer Pipette and S-IgA levels were analysed by radial immunodiffusion (a laboratory technique used to determine the concentration of an immunoglobulin). Both music and nitrous oxide interventions contained two levels: (a) level 1 = the

absence of music vs level 2 = the presence of music, and (b) level 1 = the absence of nitrous oxide vs level 2 = the presence of nitrous oxide.

Effects of the intervention/s

Music listening alone statistically significantly reduced ($p = 0.0113$) the level of stress in female patients, in contrast to male patients where there was no significant difference ($p = 0.5222$).

Table 5 Analysis of variance for female anxiety model

Source	Df	F	P-value (P < 0.05)
Music	1	6.78	0.0133
Nitrous oxide	1	2.92	0.0961
Music + nitrous oxide	1	0.22	0.6399

Table 6 Analysis of variance for male anxiety model

Source	Df	F	P-value (P < 0.05)
Music	1	0.42	0.5222
Nitrous oxide	1	0.94	0.3378
Music + nitrous oxide	1	0.00	0.9677

Music (favourite songs from a music list) vs control⁶⁴

A quasi randomised controlled trial evaluated the efficacy and validity of musical intervention to decrease anxiety and change of vital signs in 219 participants who underwent surgical extraction of an impacted mandibular third molar (IMTM) at the Seoul National University Dental Hospital (Korea).⁶⁴

Two oral and maxillofacial surgeons (OMFS) and 3 trained interviewers (dental hygienists and nurses)

conducted this study. Participants were randomly assigned to a music treated group (106 subjects) and a control group (113 subjects). There were 59 male and 47 female patients in the music treatment group and 63 male and 50 female patients in the control group. In each group, there were 53 participants who were younger than 40 years of age.

Demographic data and preoperative information (level of music preference, anticipated difficulty level of IMTM surgery) was collected from the participants. The surgical procedure was standardised and the two OMFS were familiar with the aim of the study. Patients in the music group were asked to select at least 10 of their favourite songs from a prepared music list that included classical music, pop songs, folk songs, hymns and Korean style country songs. Throughout the dental procedure, patients in the music group had the option of controlling the volume of the music using a remote control.

Patient vital signs were measured upon arrival the operating room (baseline) and throughout the operating procedure (beginning from local anaesthetic (LA) injection to completion and suturing). The main outcome of interest was patient anxiety measured preoperatively using Corah's Dental Anxiety Scale. Twenty minutes after completion of the surgery, intraoperative anxiety was assessed in the recovery room using the Dental Anxiety Scale.

The mean duration of the surgical procedure from the time of perioral sanitisation to the time of drape removal was 22.8 ± 5.71 minutes. There were no statistically significant differences in the demographic characteristics between the two groups. In addition, there were no significant differences in both the groups with respect to group distribution in difficulty level of IMTM surgery and music preferences.

Effects of the intervention

Baseline vital sign measurements were similar in both the groups. The mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) varied significantly with surgical stage for both groups. However, there were no significant interactions between stage of surgery and music treatment group, and there were no significant differences in SBP or DBP between the music treatment group and control group.

Similarly heart rate (HR) and respiratory rate (RR) varied significantly with surgical stage. However, there were significant differences between music treatment group and control group with respect to HR and RR changes from baseline.

Table 7 Repeated measures analysis of variance of music and control groups' vital signs

Category	Effect	df	F	P value (P < 0.05)
SBP	Time	2.154	199.041	0.000
	Time × group	2.154	2.478	0.081
	Group	1	0.199	0.656
DBP	Time	2.565	220.094	0.000
	Time × group	2.565	2.629	0.059
	Group	1	0.217	0.642
HR	Time	2.218	281.257	0.000
	Time × group	2.218	0.204	0.834
	Group	1	9.951	0.002*
RR	Time	2.827	5.639	0.000
	Time × group	2.827	1.785	0.152
	Group	1	6.432	0.012*

* P < 0.05

The mean anxiety level increased in the control group was 13.15 ± 2.87 before the surgery and increased to 13.51 ± 3.11 , whereas the mean anxiety level in the music treatment group was 13.42 ± 3.09 before the surgery which decreased to 13.12 ± 3.24 during the operation. Regression analysis showed that preoperative anxiety levels significantly affected intraoperative anxiety levels ($F = 248.223$, $P < 0.001$). Analysis of covariant with preoperative anxiety as a covariant showed that patients in the music treatment group had significantly lower levels of intraoperative anxiety than patients in the control group ($F = 4.226$, $P = 0.041$).

Table 8 Difference of anxiety according to music treatment

	Music treatment group	Control group	F/P
Preoperative anxiety	13.42 ± 3.09	13.15 ± 2.87	NA
Intraoperative anxiety	13.12 ± 3.24	13.51 ± 3.11	4.226/0.041*

*P < 0.05

Music (soothing piano music) vs control⁷⁷

Hui-Ling Lai et al conducted a block randomised controlled trial to investigate the effect of music on anxiety during root canal treatment and to provide a theoretical model for the effects of music on dental procedure anxiety.⁷⁷ A block of four was used in the study using a random number table. Forty four subjects between 20 and 65 years of age were recruited from a dentistry department in Taiwan and who underwent root canal treatment. There were 21 male and 23 female participants and the majority had past experience of root canal treatment.

Participants were randomised to music (n=22) and control group (n=22). Participants in the music group were exposed to a wide variety of soothing piano music through headphones with adjusted volume. Participants in the control group underwent through the same procedure without the evaluation of music

preference and a CD of silence played during the procedure. Music preference was quantified by a horizontal visual analogue scale (VAS) (0-10) developed by the researcher. Procedure-related anxiety was measured using the State-Trait Anxiety Inventory (STAI) scale, which was translated into Chinese. Physiological parameters were measured in terms of participants' HR, SBP, DBP and finger temperature (FT) using the continuous display on the DINAMAP Dash 3000 Patient Monitor.

There were no significant differences between both the groups in relation to demographic characteristics, baseline state and trait anxiety scores and experience of previous root canal treatment. Pretest anxiety scores ranged from 42 to 57 in the music group and from 42 to 58 in the control group indicating substantial anxiety in both the groups. However, there was a significant difference in relation to gender distribution with eight females and 14 males in the music group and 15 females and seven males in the control group.

Effects of the intervention

There was a significant difference ($p < 0.001$) in state anxiety scores after treatment between music group and control group, anxiety levels being higher in the later group. In addition, after controlling for pretest state anxiety, trait anxiety and gender, analysis of covariance (ANCOVA) revealed a significant difference in state anxiety for the groups ($p < 0.001$). The magnitude of effect size was 0.34.

Participants in the music group showed significantly better scores for HR over five data points. There were no statistically significant differences between both the groups in relation to HR, SBP and DBP. Additionally, there was a statistical significance for correlation between music preference and the change scores of all the outcomes.

Table 9 State of anxiety: means by group and time

<i>Time</i>	<i>Music</i>	<i>Control</i>	<i>t test</i>	<i>95% CI</i>
<i>State anxiety</i>				
<i>Pretest</i>	<i>50.64 ± 5.10</i>	<i>49.73 ± 5.49</i>	<i>0.57</i>	<i>-2.32, 4.13</i>
<i>Immediately after treatment</i>	<i>32.80 ± 3.61</i>	<i>39.55 ± 5.16</i>	<i>-5.01***</i>	<i>-9.44, -4.01</i>

(***p < 0.001)

Brief relaxation vs music distraction vs control⁷

A randomised controlled trial tested the hypothesis that brief relaxation (BR) was effective and superior to music distraction (MD) for the treatment of dental anxiety. 90 adult participants > 18 years of age who required dental treatment for simple caries (not in advanced stage) were recruited in a community dental clinical in a rural area in Germany over a six-month period.⁷ Three participants were lost to follow-up. Participants were randomised in a 1:1:1 ratio to the BR, MD or control (C) groups. Participants in control group did not receive any treatment for dental anxiety.

At first visit all participants underwent regular dental diagnostic procedures. The second visit took place within 14 days of the first visit and participants completed two questionnaires STAI and Hierarchical Anxiety Questionnaire (HAQ). The primary outcome parameter was the state subscale (STAI-S) that measures the subject's current level of anxiety. This instrument consists of two scales and total scores ranging from 20 to 80, with higher scores indicating greater anxiety. HAQ was used to stratify the intensity of dental anxiety.

Allocation concealment and blinding of participants was not possible because of the obvious characteristics of BR and MD. Intention to treat analysis was performed to account for the lost patients from the final study.

Brief relaxation involved functional relaxation that included short written instructions in the BR group in the waiting room before dental treatment. In addition the dentist explained the method to participants in

the BR group. MD involved giving participants a list of various music styles to choose from. Participants listened to music through the headphones, with volume control at their discretion throughout the dental procedure.

There were no statistically significant differences between the groups with respect to participants' demographic characteristics, except that participants in the C group were significantly older than in the MD group. STAI measures showed high state anxiety levels before dental treatment to a clinically relevant extent, scoring on an average above 40.

Effects of the intervention/s

There was a statistically significant decrease in anxiety after dental treatment in all the three groups, the most significant being in the BR group. There was a relatively small decrease in anxiety after dental treatment in the C group while MD group presented a significant reduction in state anxiety in comparison C group ($P < 0.05$). However, the anxiety reduction following BR was greater than that in the C ($P < 0.001$) and MD ($P < 0.001$) groups. In addition, only participants in the BR group exhibited a clinically relevant standardised effect size of $d = 1.25$.

Table 10 State anxiety (STAI-S) at initial and final evaluation

Group	Mean \pm SD difference between STAI-S scores	Difference in before-and-after BR STAI-S scores versus difference in before-and-after C STAI-S scores (P value)	Difference in before-and-after MD STAI-S scores versus difference in before-and-after C STAI-S scores (P value)	Difference in before-and-after BR STAI-S scores versus difference in before-and-after MD STAI-S scores (P value)
BR (n=29)	13.0 \pm 9.5	0.001	0.028	< 0.001
MD (n=28)	4.4 \pm 4.6			
C (n=30)	1.4 \pm 4.4			

Stratification of anxiety levels according to HAQ revealed that BR was effective in alleviating state anxiety throughout all levels of dental anxiety, demonstrating the largest effect in highly anxious participants. MD showed reduced anxiety in the moderately anxious subgroup.

Table 11 Effect of intervention in relationship to anxiety level before dental treatment

Anxiety level before treatment (HAQ)	Mean \pm SD difference in before-and-after BR STAI-S score	Mean \pm SD difference in before-and-after MD STAI-S score	Mean \pm SD difference in before-and-after C STAI-S score	Difference in before-and-after BR STAI-S scores versus difference in before-and-after C STAI-S scores	Difference in before-and-after MD STAI-S scores versus difference in before-and-after C STAI-S scores	Difference in before-and-after BR STAI-S scores versus difference in before-and-after MD STAI-S scores
Low (≤ 30)	9.7 \pm 6.7 (n = 15)	3.3 \pm 3.9 (n = 13)	0.8 \pm 5.4 (n = 17)	< 0.001	0.283	0.003
Moderate (31-38)	12.3 \pm 10.1 (n = 9)	7.1 \pm 5.6 (n = 10)	2.9 \pm 3.1 (n = 8)	0.001	0.045	0.008
High (> 38)	24.2 \pm 8.7 (n = 5)	2.0 \pm 1.3 (n = 5)	1.0 \pm 1.4 (n = 5)			

Chapter 4: Discussion and Conclusions

4.1 General Discussion

4.1.1 Study quality and characteristics

This review focused on music therapy or music listening as an effective intervention in the management of dental anxiety in adult and paediatric patients. Patient groups within the included studies in this review did not differ significantly on baseline demographic characteristics. Paediatric patients included in the two studies were aged between 4 and 8 years and adult patients included in the five studies aged between 18 and 65 years, with most being younger than 40 years.

All the included studies evaluated or investigated music listening as an intervention, but none of the studies included music therapy as an intervention. Five studies reported a reduction in dental anxiety in comparison to a control: one study⁷⁹ with paediatric population group and four studies^{7,63, 64,77} with adult patients as the population group.

Not all of the studies gave a clear definition of anxiety; many referred only to anxiety to describe and explain the emotional state experienced by many patients. All studies included in the review examined music listening as a therapeutic activity prior to participants having dental treatment. A wide range of music types were utilised with some giving the participants a choice from a variety of styles including classical, country and western, new age, Korean instrumental, classical and nursery rhymes. There were no differences in types of control group treatment.

Seven articles met all the necessary criteria. In all seven studies, participants were either classified as being dentally anxious or reported a higher than average level of anxiety toward dental treatment. Similarly, all studies also showed a high level of variation in the outcome measures they utilised to

define and measure dental anxiety. The primary outcome measured was dental anxiety, assessed with a variety of self-reported questionnaires, rating scales and physiological measures.

Several studies had methodological limitations affecting their reliability and validity. Despite two of the included studies being categorised as RCTs, it could be argued that no studies included in the review truly conformed to the strict rules of a RCT. Although RCT is considered the gold standard of scientific evidence, the conduct of a RCT can at times be impracticable within the real world of dental practice. Ethically, it is difficult to use a clinical control group as patients who are dentally anxious may suffer needlessly if forced to undergo dental procedures without a clinical intervention to help alleviate this anxiety.

Only one study⁷⁷ reported the concealment of treatment allocation from participants and only two studies^{36,77} reported concealment from those assessing outcomes. There is a risk of detection bias with the potential for healthcare staff and patients' increased hopes for the effectiveness of music, or conversely, a feeling of disappointment if not assigned to the treatment group. However, Clarke and Oxman in their studies examined the effect of blinding that produced conflicting results on the real impact of detection bias.⁸⁰

In the majority of the studies, the method of randomisation and the activities of the control group during the intervention were not included or clearly reported. All the included studies had small sample sizes and the sampling method used was not often clearly stated. The generalisability of much of the research is also limited owing to small samples, specific study settings/ surgical procedures and an overrepresentation of participants and studies from the USA. Factors that determine the degree that music affects people and influence their response to music include the type of music, basic personality traits, traditions or language or culture, and geographic, economic, religious and education factors.⁶²

There was also a general lack of standardisation of intervention method across various studies. This lack of standard practice, with regards to the type of music utilised or the length of the intervention,

suggests that more research is needed within this area to establish the optimal and most effective use of a music-listening intervention for reducing dental anxiety.

A variety of surveys and questionnaires were employed that included Corah's Dental Anxiety Scale^{6, 64}, modified Corah's Dental Anxiety Scale³⁶, Venham's picture test^{36, 79}, Venham's anxiety scale⁷⁹, the State Trait Anxiety Inventory (STAI)^{7,77} and Hierarchical Anxiety Questionnaire⁷. Physiological responses to anxiety, such as increased blood pressure, heart rate and respiration rate were outlined in many of the studies. In addition, radial immunodiffusion analysis was used to analyse S-IgA levels.⁶³

4.1.2 Paediatric patients

In the two studies^{36,79} that had paediatric patients as population group, Aitken et al³⁶ found that music listening did not result in any reduction of anxiety during dental procedures on young patients; therefore they concluded that music alone is ineffective as a distraction during dental procedures. However, Marwah and colleagues found that music reduced anxiety to some extent, which was not statistically significant.⁷⁹ Instrumental music was found to be significantly better in alleviating dental anxiety than music that included nursery rhymes.

The difference in findings between the two studies could be because of choice of music offered to the patients and the music volume. Klein and Winkelstein suggested that familiar songs help children gain control over an unpleasant situation and feel more familiar with the environment.⁸¹ Patients in Marwah study preferred instrumental music over nursery rhymes music.⁷⁹ This may have contributed to some reduction in dental anxiety levels, although it was not statistically significant. In addition, music was presented during the entire dental procedure in the study conducted by Marwah⁷⁹, whereas patients were exposed to music for only for five minutes in the study conducted by Aitken³⁶.

Other factors that might have contributed to the inconclusive evidence on effectiveness of music on anxiety in paediatric patients include length and nature of the dental procedure and music volume.

Buffum *et al* reported that there is a lack of an established best practice concerning the length of time required to achieve maximum benefit with regards to reduction in anxiety levels.⁸² Baghdadi stated that music reduced anxiety by eliminating unpleasant dental sounds like the sound of hand piece and suction noise.⁸³ Aitken acknowledged that music was not loud enough to mask other sounds in the dental operatory.³⁶ The other study did not provide any details on music volume. Aitken also stated that children in this age group (4-6 years) may not be capable of becoming engaged in music to the level of distraction.³⁶ It may also be possible that children may not be that capable of becoming engaged in music to the level of distraction.³⁶

Both the studies concluded that despite a lack of significant effect on anxiety levels, paediatric patients had an overwhelmingly positive response to the music and would choose to listen to it at subsequent visits. It is well known that dentally anxious children demand considerable dedication and expertise in child management techniques from the dentist and the dental staff and many management techniques have been proven successful. However, the present trend is towards non-aversive techniques such as music interventions and further research is warranted.

4.1.3 Adult patients

Five studies included in this review had adult patients as population group. Two studies^{6,7} concluded that relaxation when compared to music is an effective method of reducing patient's anxiety. However, one study stated that music when compared to no intervention may be beneficial in reducing anxiety and was found to be significantly effective in moderately anxious patients.⁷ Another study stated that music at best results in a placebo effect.⁶ The authors in this study further stated that the effect of music was similar to that of administering an inactive drug that produced beneficial effects in some patients some of the times. In both the studies, patients were offered their music of choice through headphones with volume control at their discretion.

The difference in effects between relaxation and music as stated by Lahmann lies in patient's experience of a typically anxiety-producing situation coupled with intended decrease in physiological arousal, whereas music distraction operates on a principle of overall distraction by masking fear-enhancing noises during treatment.⁷

One study concluded that music listening significantly lowered levels of anxiety and stress of females during dental procedures.⁶³ Goff and colleagues in their study concluded that there was a strong physiological response to music by females.⁶³ This was the only study that investigated the effect of music listening on lowering anxiety levels solely based on physiological measures (S-IgA levels). S-IgA, a member of the family of immunoglobulins is considered representative as a marker of physiological stress in patients undergoing stressful dental operation. This study was only able to recruit the least fearful patients; therefore the findings from this study may not be applicable or meaningful to most the most anxious patients.

Two studies provided conclusive evidence on effectiveness of music in reducing dental anxiety in this population group.^{64,77} The study conducted by Kyoung and colleagues supported their hypothesis that the use of patient-chosen music during surgical extraction of IMTM significantly lowered patient intraoperative anxiety levels.⁶⁴

The sample selected for this study had abnormally high preoperative anxiety levels as happens with people who undergo surgical treatments for diseases of the facial and oral regions.⁸⁴ "IMTM surgery is generally perceived by patients and general dentists as an intensely frightening procedure and remains a challenging operation associated with numerous intra- and postoperative complications that may be more serious than originally expected by the patient".⁶⁴ The study, as with the majority of the studies included in this review recommended the use of volume-controllable headsets over external speakers to avoid distracting surgical staff member's concentration during surgery.

The study conducted by Lai et al provided clear evidence for dentists and nurses for the use of soothing music for reducing anxiety in adult patients who underwent root canal treatment.⁷⁷ This study did not provide an opportunity for patients to choose their own music.⁷⁷ It has been reported that majority of adults undergo one or more root canal treatments during their lifetime.⁸⁵ Anxiety in patients undergoing root canal treatment, as in most patients undergoing invasive medical procedures, may be due to concerns about the physical discomfort caused by the invasive procedure itself.

4.1.4 Length of exposure

The length of time participants were exposed to the intervention varied between 5 minutes and 1 hour, although the majority of the studies did not specify the length of time. However, it should be noted that the length of time listening to music should not be intrusive to the clinicians and thereby affect clinical scheduling.⁸⁶

4.1.5 Music preference and music volume

Some studies emphasised the importance of personal preference, when using a music intervention to reduce levels of anxiety, because of the individualised nature of music listening. Psychophysiological theory synthesised from the literature states that certain type of music induces relaxation and pleasure responses that reduces activity in the neuroendocrine and sympathetic nervous system, which results in decreased anxiety, heart rate and respiratory rate.⁸⁷

Kyoung et al stated that clinicians should consider patients' music preferences and familiarity with selected music to maximise the anxiolytic effects of music interventions.⁶⁴ In addition, several other studies emphasised the importance of personal preference, when using a music intervention to direct levels of anxiety, because of the individualised nature of music listening.^{88,89} It is also recommended that it is necessary for patients to select the appropriate music volume to prevent discomfort and fatigue

during the intervention. Hence volume-controllable headsets are recommended over external speakers to avoid distracting surgical staff members' concentration during surgery.⁶⁴

4.1.6 Reduction in dental anxiety

Reduction in dental anxiety can be attributed to two reasons: 1) listening to music, the patient tends to close his/ her eyes to concentrate on the music, there by screening out the sight of dental injection, dental drill and other dental instruments like dental forceps (e.g. cow horn) and 2) music eliminates the unpleasant sounds in dental clinic like the sound of Air rotor hand-piece. Music theorists including Bonny⁵³, Gfeller⁵⁴ and Guzzetta⁵⁵ state that music has the ability to distract and divert attention away from stressful stimuli, promote feelings of physical and mental relaxation by refocusing attention on to pleasurable emotional states and block unpleasant environmental sounds. Majority of the studies included in this review reflected this ability of music.^{7, 63, 64, 77, 79}

Silberstein stated that “music can be as effective as nitrous oxide in reducing anxiety and is most effective when the musical program is selected by the patient and many patients like the stereophonic music so much that they become engrossed in the music as soon as they get settled in the dental chair”.⁹⁰ The positive trend suggesting that music may be beneficial in reducing dental anxiety, although not statistically significant, indicates the value of further investigation. People have long found the dental situation stressful. Attempts to develop means of reducing excessive anxiety and stress in these patients will benefit not only the patients but also make the dentist's task easier to accomplish.

A 2008 systematic review concluded that music intervention was effective in reducing anxiety and pain in children and adults undergoing medical procedures.⁵⁷ However, the limited-quality evidence was inconclusive and indistinctive in terms of patients or settings. The quantitative studies included in this review did not provide conclusive evidence on the effectiveness of music in reducing anxiety in children, which are in agreement with this review. However, the review concluded that music was

effective in reducing anxiety in children in undergoing dental procedures based on the findings from a qualitative analysis.

4.2 Implications for practice

There is some evidence to offer support to music listening in adult patients. It is recommended that pre-recorded music be offered through headphones during the dental procedure to adult patients to reduce their dental anxiety. Provision of music is safe, inexpensive, lacks harmful side effects and is easy to implement. The evidence on the effectiveness of music in reducing dental anxiety in children is inconclusive. However, it is worth exploring as a potentially effective adjunctive intervention to standard care in children. All results and conclusions show that music listening is worth an intervention that dentists can use it as an effective tool in managing dental anxiety in their patients.

In the absence of stronger evidence, where possible, participants should be allowed a choice of musical styles/genre, perhaps allowing them the option of bringing their own CDs with them. Music can be useful nonpharmacological adjunctive intervention and is preferable over pharmacological treatments to reduce dental anxiety in both children and adults. These results, however, must be interpreted with caution. The included studies were generally of poor to moderate quality and in many cases the number of participants included in the trials was small.

4.3 Implications for research

Even though the results seem to show, in the most part, consistently positive and statistically significant changes, the wide variety of research designs and variables, such as group designs, variety of music used and outcomes measurement scales means that a meta-analysis could not be performed. More research needs to be performed before it is possible to show, with a higher degree of certainty, that music listening does have a significant effect on the reduction of dental anxiety, particularly in children.

Future studies, most likely randomised controlled trials should evaluate music therapy as an intervention for managing dental anxiety.

Future research studies should incorporate large sample sizes (n=100) to ensure adequate statistical power to detect any differences between the treatment groups; however, consultations with a statistician are worthwhile. The diversity of music utilised indicates a need for further research in this area. Future studies should focus on music interventions based on the importance of personal music preference in comparison with pre-selected music and the length of exposure to music necessary to achieve the maximum benefit in terms of a reduction in dental anxiety.

4.4 Conclusions

This study concludes that there is some evidence on the effectiveness of music listening in managing anxiety in adult patients undergoing dental procedures. In paediatric patients, however, the evidence remains inconclusive. However, music can be an effective method of enhancing patient co-operation, without any associated morbidity and is widely available for implementation by all general dental practitioners.

4.4.1 Key Findings

The key findings are classified as level II evidence based on the Joanna Briggs Institute levels of evidence (Appendix 6):

- The evidence on effectiveness of music listening in children in reducing dental anxiety is mixed.
- Evidence from a study conducted in India suggests that instrumental music is effective than nursery rhymes in reducing dental anxiety in children.
- Paediatric patients react positively to the music and would choose to listen to it at subsequent visits.
- Passive music listening significantly lowers S-IgA levels thereby reducing dental anxiety in adult female patients.

- Patient preferred music and music offered through headphones with an option for adult patients to control the volume helps in reducing dental anxiety.
- Soothing, classical, pop and country music are some the music styles preferred by adult patients during dental treatment to reduce their anxiety.
- Length of time listening to music may be an important factor to consider for it to be effective.

4.4.2 Recommendations

- Music is an effective and useful tool for dental care professionals for managing patients' dental anxiety, particularly in adults. Music will particularly help in blocking out the noise of the drill.
- Music may be considered as an adjunctive therapy, where possible with other distraction techniques in managing dental anxiety in children.
- Dental care professionals should consider adopting music in their daily practice.
- Dentists should consider asking adult patients to bring their own portable music play and with their list of favourite songs to listen throughout the dental treatment.
- Dental offices/operators may be equipped with music with headphones and small compact CD players.
- Loud music should be avoided. Soothing and relaxing should be the preferred choice of music.

4.4.3 Limitations

The search was restricted to English language and languages where translations were available (e.g. Chinese, Japanese, Italian); however, there may have been studies in other languages relevant to this review. This review focused only on dental anxiety; however, other outcomes such as pain in these population groups need to be investigated. The validity of the results of this review is limited by the methods of included primary studies.

The studies included are notably lacking in follow-up data, without which it is impossible to make any valid statements about clinical value. The results of this review should be interpreted with caution in light of the variable methodological quality of the included studies and small sample sizes.

Appendix 1: Critical Appraisal Instrument

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear
1. Was the assignment to treatment groups truly random?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were participants blinded to treatment allocation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was allocation to treatment groups concealed from the allocator?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were the outcomes of people who withdrew described and included in the analysis?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were those assessing outcomes blind to the treatment allocation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were the control and treatment groups comparable at entry?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were groups treated identically other than for the named interventions?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were outcomes measured in the same way for all groups?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Were outcomes measured in a reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info.

Comments (Including reasons for exclusion)

Appendix 2: Data Extraction Instrument

Author Record Number

Journal

Year

Reviewer

Method _____

Setting _____

Participants _____

Number of Participants

Group A Group B

Interventions

Intervention A _____

Intervention B _____

Outcome Measures

Outcome Description	Scale/Measure

Results**Dichotomous Data**

Outcome	Treatment Group Number/total number	Control Group Number/total number

Continuous Data

Outcome	Treatment Group Mean & SD (number)	Control Group Mean & SD (number)

Authors Conclusion

Reviewers Conclusion

Appendix 3: Detailed Search Strategy

PICO (Participants, Interventions, Comparators and Outcomes) strategy

	Participant	Intervention	Comparator	Outcome
↓	Adult*	Music	Talking	Dental anxiety
	Pediatric	Music therapy	Placebo	Stress
	Paediatric Patient*	Music listening	Headphones NOT music	Dental fear
	Child	Active music therapy	Relaxation	Dental phobia
	Young adult	Passive music listening	Sedation	Anxiety disorder
	Children	Audio recording	Pharmacological	Worry
OR		Mp3 hearing	Anti anxiety drugs	Procedure anxiety
↓			Muscle relaxation	
↓			Conscious sedation	

Search Histories (only from four major databases provided)

Cochrane Central Register of Controlled Trials

#1 (music):ti,ab,kw or (music therapy):ti,ab,kw or (music listening):ti,ab,kw in Clinical Trials

#2 (tape recording):ti,ab,kw or (audio listening):ti,ab,kw or (prerecorded music):ti,ab,kw or (mp3):ti,ab,kw or (audiotapes):ti,ab,kw in Clinical Trials

#3 (#1 OR #2)

#4 (dental anxiety):ti,ab,kw or (dental state anxiety):ti,ab,kw or (dental procedure anxiety):kw or (dental fear):ti,ab,kw or (dental phobia):ti,ab,kw in Clinical Trials

#5 (#3 AND #4)

Medline

Pediatric

Paediatric

paediatric patients

pediatric patients

Children

Child

(pediatric) OR (paediatric) OR (paediatric patients) OR (pediatric patients) OR (children) OR (child)

Adult

young adults

young adult

older adults

adult*[Title/Abstract]

(adult) OR (young adults) OR (young adult) OR (older adults) OR (adult*[Title/Abstract])

Music

music therapy

music listening

active music therapy

passive music listening

audio recording

audio visual

mp3 hearing

(music) OR (music therapy) OR (music listening) OR (active music therapy) OR (passive music listening) OR (audio recording) OR (audio visual) OR (mp3 hearing)

Talking

talking therapy

Placebo

(placebo) NOT (music)

Relaxation

relaxation techniques

relaxation therapy

muscle relaxation

anti anxiety medication

anti anxiety drugs

Sedation

conscious sedation

procedural sedation

sedation dentistry

(talking) OR (talking therapy) OR (placebo) OR ((placebo) NOT (music)) OR (relaxation) OR (relaxation techniques) OR (relaxation therapy) OR (muscle relaxation) OR (anti anxiety medication) OR (anti anxiety drugs) OR (sedation) OR (conscious sedation) OR (procedural sedation) OR (sedation dentistry)

dental anxiety

dental anxiety fear

dental fear

dental fears

Panic

anxiety panic

anxiety disorder

Worry

procedure anxiety

(dental anxiety) OR (dental anxiety fear) OR (dental fear) OR (dental fears) OR (panic) OR (anxiety

panic) OR (anxiety disorder) OR (worry) OR (procedure anxiety)

randomized controlled trial

randomized controlled trials

prospective randomized controlled trial

therapy randomized controlled trial

randomized controlled trial placebo

clinical trial

clinical trials

randomized clinical trial

(randomized controlled trial) OR (randomized controlled trials) OR (prospective randomized controlled trial) OR (therapy randomized controlled trial) OR (randomized controlled trial placebo) OR (clinical trial) OR (clinical trials) OR (randomized clinical trial)

observational study

observational studies

prospective observational study

descriptive study

descriptive studies

(observational study) OR (observational studies) OR (prospective observational study) OR (descriptive study) OR (descriptive studies)

((pediatric) OR (paediatric) OR (paediatric patients) OR (pediatric patients) OR (children) OR (child)) AND ((music) OR (music therapy) OR (music listening) OR (active music therapy) OR (passive music listening) OR (audio recording) OR (audio visual) OR (mp3 hearing)) AND ((talking) OR (talking therapy) OR (placebo) OR ((placebo) NOT (music)) OR (relaxation) OR (relaxation techniques) OR (relaxation therapy) OR (muscle relaxation) OR (anti anxiety medication) OR (anti anxiety drugs) OR (sedation) OR (conscious sedation) OR (procedural sedation) OR (sedation dentistry)) AND ((dental anxiety) OR (dental anxiety fear) OR (dental fear) OR (dental fears) OR (panic) OR (anxiety panic) OR (anxiety disorder) OR (worry) OR (procedure anxiety)) AND ((randomized controlled trial) OR (randomized controlled trials) OR (prospective randomized controlled trial) OR (therapy randomized controlled trial) OR (randomized controlled trial placebo) OR (clinical trial) OR (clinical trials) OR

(randomized clinical trial))

((pediatric) OR (paediatric) OR (paediatric patients) OR (pediatric patients) OR (children) OR (child)) AND ((music) OR (music therapy) OR (music listening) OR (active music therapy) OR (passive music listening) OR (audio recording) OR (audio visual) OR (mp3 hearing)) AND ((dental anxiety) OR (dental anxiety fear) OR (dental fear) OR (dental fears) OR (panic) OR (anxiety panic) OR (anxiety disorder) OR (worry) OR (procedure anxiety)) AND ((randomized controlled trial) OR (randomized controlled trials) OR (prospective randomized controlled trial) OR (therapy randomized controlled trial) OR (randomized controlled trial placebo) OR (clinical trial) OR (clinical trials) OR (randomized clinical trial))

((pediatric) OR (paediatric) OR (paediatric patients) OR (pediatric patients) OR (children) OR (child)) AND ((music) OR (music therapy) OR (music listening) OR (active music therapy) OR (passive music listening) OR (audio recording) OR (audio visual) OR (mp3 hearing)) AND ((dental anxiety) OR (dental anxiety fear) OR (dental fear) OR (dental fears) OR (panic) OR (anxiety panic) OR (anxiety disorder) OR (worry) OR (procedure anxiety)) AND ((observational study) OR (observational studies) OR (prospective observational study) OR (descriptive study) OR (descriptive studies))

((adult) OR (young adults) OR (young adult) OR (older adults) OR (adult*[Title/Abstract])) AND ((music) OR (music therapy) OR (music listening) OR (active music therapy) OR (passive music listening) OR (audio recording) OR (audio visual) OR (mp3 hearing)) AND ((talking) OR (talking therapy) OR (placebo) OR ((placebo) NOT (music)) OR (relaxation) OR (relaxation techniques) OR (relaxation therapy) OR (muscle relaxation) OR (anti anxiety medication) OR (anti anxiety drugs) OR (sedation) OR (conscious sedation) OR (procedural sedation) OR (sedation dentistry)) AND ((dental anxiety) OR (dental anxiety fear) OR (dental fear) OR (dental fears) OR (panic) OR (anxiety panic) OR (anxiety disorder) OR (worry) OR (procedure anxiety)) AND ((randomized controlled trial) OR (randomized controlled trials) OR (prospective randomized controlled trial) OR (therapy randomized controlled trial) OR (randomized controlled trial placebo) OR (clinical trial) OR (clinical trials) OR (randomized clinical trial))

((adult) OR (young adults) OR (young adult) OR (older adults) OR (adult*[Title/Abstract])) AND ((music) OR (music therapy) OR (music listening) OR (active music therapy) OR (passive music listening) OR (audio recording) OR (audio visual) OR (mp3 hearing)) AND ((talking) OR (talking therapy) OR (placebo) OR ((placebo) NOT (music)) OR (relaxation) OR (relaxation techniques) OR (relaxation therapy) OR (muscle relaxation) OR (anti anxiety medication) OR (anti anxiety drugs) OR (sedation) OR (conscious sedation) OR (procedural sedation) OR (sedation dentistry)) AND ((dental anxiety) OR (dental anxiety fear) OR (dental fear) OR (dental fears) OR (panic) OR (anxiety panic) OR (anxiety disorder) OR (worry) OR (procedure anxiety)) AND ((observational study) OR (observational studies) OR (prospective observational study) OR (descriptive study) OR (descriptive studies))

((adult) OR (young adults) OR (young adult) OR (older adults) OR (adult*[Title/Abstract])) AND ((music) OR (music therapy) OR (music listening) OR (active music therapy) OR (passive music listening) OR (audio recording) OR (audio visual) OR (mp3 hearing)) AND ((dental anxiety) OR (dental anxiety fear) OR (dental fear) OR (dental fears) OR (panic) OR (anxiety panic) OR (anxiety disorder) OR (worry) OR (procedure anxiety)) AND ((randomized controlled trial) OR (randomized controlled trials) OR (prospective randomized controlled trial) OR (therapy randomized controlled trial) OR (randomized controlled trial placebo) OR (clinical trial) OR (clinical trials) OR (randomized clinical trial))

trial))

((adult) OR (young adults) OR (young adult) OR (older adults) OR (adult*[Title/Abstract])) AND ((music) OR (music therapy) OR (music listening) OR (active music therapy) OR (passive music listening) OR (audio recording) OR (audio visual) OR (mp3 hearing)) AND ((dental anxiety) OR (dental anxiety fear) OR (dental fear) OR (dental fears) OR (panic) OR (anxiety panic) OR (anxiety disorder) OR (worry) OR (procedure anxiety)) AND ((observational study) OR (observational studies) OR (prospective observational study) OR (descriptive study) OR (descriptive studies))

dental anxiety

Music

music AND dental anxiety

music and DA PICO

music anxiety setting

music anxiety rct procedure

music setting rct

music anxiety procedure

music rct procedure

music anxiety setting

CINAHL

S35 - S9 and S18 and S26

S34 - S6 and S18 and S25

S33 - S5 and S18 and S25

S32 - S9 and S18 and S25 and S26

S31 - S9 and S18 and S25

S30 - S26 or S27 or S28 or S29

S29 - (MH "Double-Blind Studies") OR (MH "Triple-Blind Studies") OR double blind studies

S28 - (MM "Quantitative Studies") OR descriptive studies

S27 - (MM "Nonexperimental Studies+") OR (MM "Quasi-Experimental Studies") OR (MM "Concurrent Prospective Studies") OR (MM "Cross Sectional Studies") OR non experimental studies

OR (MH "Case Control Studies+") OR (MH "Comparative Studies") OR (MH "Correlational Studies")
OR (MH "Double-Blind Studies")

S26 - (MM "Clinical Trials+") OR (MM "Intervention Trials") OR (MM "Nonrandomized Trials") OR
randomized controlled trial OR (MM "Community Trials") OR (MM "Therapeutic Trials") OR (MH
"Control Group") OR (MM "Clinical Trial Registry") OR (MH "Random Assignment") OR (MM
"Multicenter Studies") OR (MM "Pretest-Posttest Control Group Design")

S25 - S22 or S23 or S24

S24 - (MM "Dental Care+") OR dental care OR (MM "Dental Care for Children")

S23 - dental treatment

S22 - dental procedure

S21 - S19 or S20

S20 - AB dental hospital or AB dental practice or AB emergency dental office or AB dental teaching
hospital

S19 - (MM "Dental Offices") OR dental office OR (MM "Dental Clinics") OR (MM "Dental Facilities+")
OR (MM "Dental Health Services+")

S18 - S16 or S17

S17 - AB dental fear or AB dental phobia or AB dental state anxiety

S16 - (MM "Anxiety+") OR anxiety OR (MM "Dental Anxiety") OR (MM "Anxiety Disorders") OR (MM
"Self-Rating Anxiety Scale") OR (MM "State-Trait Anxiety Inventory") OR (MM "Death Anxiety Scale")
OR (MH "Phobic Disorders+")

S15 - S10 or S11 or S12 or S13 or S14

S14 - (MM "Antianxiety Agents+") OR (MH "Antianxiety Agents, Benzodiazepine+") OR anti anxiety
drugs

S13 - (MM "Sedation") OR sedation OR (MM "Conscious Sedation")

S12 - AB relaxation therapy or AB relaxation techniques or AB muscle relaxation

S11 - (MM "Placebos") OR (MM "Placebo Effect") OR placebo

S10 - AB talking or AB (headphones NOT music)

S9 - S5 or S6 or S7 or S8

S8 - AB passive music therapy or AB active music therapy or AB passive music listening

S7 - AB audio recording or AB tape recording or AB prerecorded music or AB mp3 or AB audio tapes

S6 - (MM "Listening") OR music listening

S5 - (MM "Music Therapy") OR music therapy OR (MM "Music")

S4 - S1 or S2 or S3

S3 - (MM "Adult+") OR adult OR (MM "Young Adult")

S2 - pediatric

S1 - (MM "Child+") OR child

PsycINFO

S41 - KW music and KW dental anxiety

S40 - S38 and S39

S39 - MJ dental anxiety or KW dental state anxiety or KW dental fear or KW anxiety disorders or KW dental phobia

S38 - S36 or S37

S37 - AB tape recording or KW mp3 or KW prerecorded music or KW audiotapes

S36 - MJ music therapy or MJ music or MJ music listening

S35 - S9 and S18 and S26

S34 - S6 and S18 and S25

S33 - S5 and S18 and S25

S32 - S9 and S18 and S25 and S26

S31 - S9 and S18 and S25

S30 - S26 or S27 or S28 or S29

S29 - (MH "Double-Blind Studies") OR (MH "Triple-Blind Studies") OR double blind studies

S28 - (MM "Quantitative Studies") OR descriptive studies

S27 - (MM "Nonexperimental Studies+") OR (MM "Quasi-Experimental Studies") OR (MM "Concurrent Prospective Studies") OR (MM "Cross Sectional Studies") OR non experimental studies OR (MH "Case Control Studies+") OR (MH "Comparative Studies") OR (MH "Correlational Studies") OR (MH "Double-Blind Studies")

S26 - (MM "Clinical Trials+") OR (MM "Intervention Trials") OR (MM "Nonrandomized Trials") OR randomized controlled trial OR (MM "Community Trials") OR (MM "Therapeutic Trials") OR (MH "Control Group") OR (MM "Clinical Trial Registry") OR (MH "Random Assignment") OR (MM "Multicenter Studies") OR (MM "Pretest-Posttest Control Group Design")

S25 - S22 or S23 or S24

S24 - (MM "Dental Care+") OR dental care OR (MM "Dental Care for Children")

S23 - dental treatment

S22 - dental procedure

S21 - S19 or S20

S20 - AB dental hospital or AB dental practice or AB emergency dental office or AB dental teaching hospital

S19 - (MM "Dental Offices") OR dental office OR (MM "Dental Clinics") OR (MM "Dental Facilities+") OR (MM "Dental Health Services+")

S18 - S16 or S17

S17 - AB dental fear or AB dental phobia or AB dental state anxiety

S16 - (MM "Anxiety+") OR anxiety OR (MM "Dental Anxiety") OR (MM "Anxiety Disorders") OR (MM "Self-Rating Anxiety Scale") OR (MM "State-Trait Anxiety Inventory") OR (MM "Death Anxiety Scale") OR (MH "Phobic Disorders+")

S15 - S10 or S11 or S12 or S13 or S14

S14 - (MM "Antianxiety Agents+") OR (MH "Antianxiety Agents, Benzodiazepine+") OR anti anxiety drugs

S13 - (MM "Sedation") OR sedation OR (MM "Conscious Sedation")

S12 - AB relaxation therapy or AB relaxation techniques or AB muscle relaxation

S11 - (MM "Placebos") OR (MM "Placebo Effect") OR placebo

S10 - AB talking or AB (headphones NOT music)

S9 - S5 or S6 or S7 or S8

S8 - AB passive music therapy or AB active music therapy or AB passive music listening

S7 - AB audio recording or AB tape recording or AB prerecorded music or AB mp3 or AB audio tapes

S6 - (MM "Listening") OR music listening

S5 - (MM "Music Therapy") OR music therapy OR (MM "Music")

S4 - S1 or S2 or S3

S3 - (MM "Adult+") OR adult OR (MM "Young Adult")

S2 - pediatric

S1 - (MM "Child+") OR child

Appendix 4: Included Studies

Author/year/country	Aitken JC, Wilson S, Coury D and Moursi AM/ 2002/ USA ³⁶
Study	The effect of music distraction on pain, anxiety and behaviour in paediatric dental patients.
Method	Quasi experimental study
Participants	45 children between 48 to 83 months who required restorative dental treatment
Intervention	Upbeat music distraction Relaxing music distraction No music (headphones without music - control) Patients were exposed to music only for 5 min.
Outcomes	Dental anxiety <i>Parent reported anxiety – Modified Corah Anxiety scale</i> <i>Patient reported anxiety – Venham picture test</i>
Risk of bias/allocation concealment	No clear process of randomisation described. There was allocation concealment and investigator blinding.
Level of evidence	II
Notes	Audio music distraction did not produce a reduction in anxiety in young paediatric patients. However, patients had an overwhelmingly positive response to the music and would choose to listen to it at subsequent visits.

Author/year/country	Corah NL, Gale EN, Pace LF and Seyrek SK/ 1981/ USA ⁶
Study	Relaxation and musical programming as means of reducing psychological stress during dental procedures.
Method	Quasi RCT
Participants	80 college students (40 men & 40 women) who required a minimum of class II amalgam restorations
Intervention	Relaxation Music Music with volume control Control group
Outcomes	Dental anxiety – Corah Dental Anxiety scale and several self-rating subscales
Risk of bias/allocation concealment	Randomisation not clear and no allocation concealment and blinding.
Level of evidence	II
Notes	Results indicate that relaxation is an effective method of reducing patient's anxiety. Results with musical programming suggest that music at best results in a placebo effect.

Author/year/country	Goff LC, Pratt RR and Madrigal JL/ 1997/ USA ⁶³
Study	Music listening and S-IgA levels in patients undergoing a dental procedure.
Method	Quasi RCT
Participants	80 males and females between 18 & 65 years of age who required preparation of tooth for the manufacture and subsequent cementing of the crown.
Intervention	Local anaesthesia (LA) only LA + music LA + nitrous oxide/oxygen LA + music + nitrous oxide/oxygen
Outcomes	S-IgA level using radial immunodiffusion analysis of S-IgA.
Risk of bias/allocation concealment	No clear description of methodology and data provided is incomplete.
Level of evidence	II
Notes	There is a strong physiologic response to music by females that equals or surpasses their response to nitrous oxide. Music offers nonpharmacological intervention for anxiety when nitrous oxide is contraindicated.

Author/year/country	Yu-Kyoung K, Soung-Min K and Hoon M/ 2010/ South Korea ⁶⁴
Study	Musical Intervention Reduces Patients' Anxiety in Surgical Extraction of an Impacted Mandibular Third Molar.
Method	Quasi RCT
Participants	219 patients who underwent surgical extraction of impacted third mandibular molar (IMTM)
Intervention	Music treated group (patients were asked to choose atleast 10 songs from a list) Control group
Outcomes	Pre- and post-operative dental anxiety – Corah's Dental Anxiety scale
Risk of bias/allocation concealment	Randomisation process unclear. No allocation concealment and blinding.
Level of evidence	II
Notes	Use of patient chosen music during surgical extraction of IMTM significantly lowers patient intraoperative anxiety levels.

Author/year/country	Lahmann C, Schoen R, Henningsen P, et al./ 2008/ Germany ⁷
Study	Brief Relaxation Versus Music Distraction in the Treatment of Dental Anxiety: A Randomised Controlled Clinical Trial.
Method	RCT
Participants	90 adults > 18 years of age who required dental treatment for simple caries.
Intervention	Brief relaxation (BR) (functional relaxation) Music distraction (MD) (user listens to pleasant music with various music styles) Control group – no treatment for dental anxiety
Outcomes	Anxiety – State Trait Anxiety Scale (STAI) & Hierarchical Anxiety Questionnaire
Risk of bias/allocation concealment	Randomisation process clear. Allocation concealment and blinding.
Level of evidence	II
Notes	For the anxious patient who visits dentist voluntarily, BR can be pragmatic, effective method of facilitating dental treatment. BR is more effective than MD, although MD is beneficial when compared to Control group.

Author/year/country	Hui-Ling L, Ming-Jay H, Chia-Jung C, et al./ 2008/ Taiwan ⁷⁷
Study	Randomised controlled trial of music on state anxiety and physiological indices in patients undergoing root canal treatment.
Method	Block RCT
Participants	44 subjects between 20-65 years of age who underwent root canal treatment
Intervention	Music group (music for 60 min by the use of a variety of soothing piano music) Control group
Outcomes	Anxiety – STAI Physiological measures – Heart Rate, Blood Pressure & Finger Temperature (FT)
Risk of bias/allocation concealment	Randomisation process clear with allocation concealment. Blinding unclear.
Level of evidence	II
Notes	Relaxing music administered through headphones to subjects during root canal treatment decreased the procedure-related anxiety of the patients & significantly increased FT. Finding provide necessary support for the use of music during root canal treatment as a safe intervention & as a remarkably potent intervention against anxiety.

Author/year/country	Marwah N, Prabhakar AR and Raju OS/ 2005/ India ⁷⁹
Study	Music distraction - Its efficacy in management of anxious paediatric dental patients.
Method	Quasi RCT
Participants	40 children between 4 & 8 years with no previous dental experience. Oral prophylaxis, preparation & restoration of teeth and extraction of decayed teeth.
Intervention	Control group Instrumental music group Nursery Rhymes group
Outcomes	Anxiety – Venham’s picture test and Venham’s anxiety scale Physiological – Pulse rate and oxygen saturation through pulse oximeter
Risk of bias/allocation concealment	No description of randomisation, allocation concealment and blinding
Level of evidence	II
Notes	Audio distraction did decrease the anxiety level in the paediatric patients although not to a very significant level. Instrumental music was the music of choice. Despite lack of any relief patients had an overwhelming positive response to the music presentation and wanted to hear it at their subsequent visits.

Appendix 5: Excluded Studies

A. Excluded studies on full-text examination

Reference no:	Study Title	Reasons for exclusion
1.	Increasing dental patients' access to measures for anxiety, fear, and phobia management. Perspectives from a community-based research program	Study on perspectives and experiences
2.	Complementary and alternative medicine: impact on dentistry	Looking at complementary medicines include herbal remedies, homeopathic medicines, and essential oils.
3.	The effect of ambient music upon the reactions of children undergoing dental treatment	Cohort study but lacking control
4.	Relaxation effect of an audiovisual system on dental patients. Part 2. Palus-amplitude	Intervention not relevant – different audiovisual instrument
5.	Calming patients: DA tapes songs to relax children	Not the relevant study type
6.	The psychosomatic effect of the sonic environment in the dental office	Not relevant to the study, different outcome measures.
7.	Use of alternative medical therapies in the perioperative period: Is it time to get on board?	Not related to dental anxiety
8.	The effect of humorous and musical distraction of preoperative anxiety	Related to medical surgical procedures
9.	The use of music during the immediate postoperative recovery period	Related to medical surgical procedures and anaesthesia
10.	Introducing a music programme to reduce preoperative anxiety	Related to medical surgical procedures
11.	Use of aromatherapy and music therapy to reduce anxiety and pain perception in dental hygiene	Literature review
12.	Effect of music on vital signs and postoperative pain	Related to medical procedures
13.	The effect of music on preoperative anxiety in day surgery	Related to day surgery medical procedures
14.	Effects of music therapy on anxiety levels and pain perception	Descriptive study and related to medical procedures
15.	Music therapy with female surgical patients: effect on anxiety and pain	Related to medical surgical procedures
16.	Anxiety reduction through humorous audiotapes in paediatric dental patients	Intervention – humorous audio tapes, not music
17.	A comparison between audio and audiovisual	Interventions not relevant and no clear

	distraction techniques in managing anxious paediatric dental patients	data provided
18.	Effects of sedative music on patient preoperative anxiety	Related to medical procedures
19.	Relaxing effects of music in dentistry for mentally handicapped patients	Population group not relevant, special needs population
20.	The Use of Choice-Based Distraction to Decrease the Distress of Children at the Dentist	Interventions and outcome measures not relevant to this review
21.	Strategies for combating dental anxiety	Survey data on dental anxiety in general
22.	Music therapy may reduce pain and anxiety in children undergoing medical and dental procedures	Summary of another study
23.	The effectiveness of music as an intervention for hospital patients: a systematic review	Related to medical procedures
24.	Effectiveness of complementary and self-help treatments for anxiety disorders	Not the relevant intervention
25.	Music for pain and anxiety in children undergoing medical procedures: a systematic review of randomised controlled trials	Systematic review used as a reference in background and in discussion.
26.	Anxiolytic intervention preference of dental practitioners in the Savannah, Chatham County area: a pilot study	Survey study on anxiolytic intervention preferences

B. Studies excluded after critical appraisal

27.	Does Music during a Dental Treatment Make a Difference?	Not enough details to make a conclusion
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Appendix 6: The Joanna Briggs Institute Levels of Evidence

Levels of Evidence	Feasibility F(1-4)	Appropriateness A(1-4)	Meaningfulness M(1-4)	Effectiveness E(1-4)	Economic Evidence
1	Metasynthesis of research with unequivocal synthesised findings	Metasynthesis of research with unequivocal synthesised findings	Metasynthesis of research with unequivocal synthesised findings	Meta-analysis(with homogeneity) of experimental studies (e.g. RCT with concealed randomisation) OR One or more large experimental studies with narrow confidence intervals	Metasynthesis (with homogeneity) of evaluations of important alternative interventions comparing all clinically relevant outcomes against appropriate cost measurement, and including a clinically sensible sensitivity analysis
2	Metasynthesis of research with credible synthesised findings	Metasynthesis of research with credible synthesised findings	Metasynthesis of research with credible synthesised findings	One or more smaller RCTs with wider confidence intervals OR Quasi-experimental studies(without randomisation)	Evaluations of important alternative interventions comparing all clinically relevant outcomes against appropriate cost measurement, and including a clinically sensible sensitivity analysis
3	a. Metasynthesis of text/opinion with credible synthesised findings b. One or more single research studies of high quality	a. Metasynthesis of text/opinion with credible synthesised findings b. One or more single research studies of high quality	a. Metasynthesis of text/opinion with credible synthesised findings b. One or more single research studies of high quality	a. Cohort studies (with control group) b. Case-controlled c. Observational studies(without control group)	Evaluations of important alternative interventions comparing a limited number of appropriate cost measurement, without a clinically sensible sensitivity analysis
4	Expert opinion	Expert opinion	Expert opinion	Expert opinion, or physiology bench research, or consensus	Expert opinion, or based on economic theory

References

1. Hmud R, Walsh LJ. Dental anxiety: causes, complications and management approaches. *JMID*. 2009; 2:1.
2. Klingberg G, Broberg AG. Dental fear/anxiety and dental behaviour management problems in children and adolescents: a review of prevalence and concomitant psychological factors. *Int J Paediatr Dent*. 2007; 17(6):391-406.
3. Eli I. Dental anxiety: a cause for possible misdiagnosis of tooth vitality. *Int Endod J* 1993; 26(4):251-253.
4. Spielberger CD. *Manual for the State-Trait Anxiety Inventory (STAI)*. Palo Alto, CA: Consulting Psychologists Press, 1983.
5. *Encyclopaedia of medical concepts*. National Library of Medicine, Ontario, Canada; 2009. [cited 2010 June 4]. Available from <http://www.reference.md/files/D016/mD016854.html>.
6. Corah NL, Gale EN, Pace LF, Seyrek SK. Relaxation and musical programming as means of reducing psychological stress during dental procedures. *J Am Dent Assoc*. 1981; 103(2):232-4.
7. Lahmann C, Schoen R, Henningsen P, Ronel J, Muehlbacher M, Loew T, et al. Brief Relaxation Versus Music Distraction in the Treatment of Dental Anxiety: A Randomised Controlled Clinical Trial. *J Am Dent Assoc* 2008; 139 (3): 317-324.
8. Bernson JM, Elfström ML, Berggren U. Self-reported dental coping strategies among fearful adult patients: preliminary enquiry explorations. *Eur J Oral Sci*. 2007; 115(6):484-90.
9. Bray A, Chhun A, Donkersgoed R, Hoover S, Levitan S. An Evidence-based report investigating the most effective method to reduce dental anxiety. University of Toronto, Toronto, Canada.2009.
10. Thomson WM, Stewart JF, Carter KD, Spencer AJ. Dental anxiety among Australians. *Int Dent J*. 1996; 46: 320-4.
11. Matharu L, Ashley PF. Sedation of anxious children undergoing dental treatment. *Cochrane Database Syst Rev*. 2006; 1.
12. Stouthard ME, Hoogstraten J. Prevalence of dental anxiety in the Netherlands. *Community Dent Oral Epidemiol*. 1990; 18(3):139-142.
13. Hakeberg M, Berggren U, Carlsson SG. Prevalence of dental anxiety in an adult population in a major urban area in Sweden. *Community Dent Oral Epidemiol*. 1992; 20(2):97-101.
14. Gatchel RJ, Ingersoll BD, Bowman L, Robertson MC, Walker C. The prevalence of dental fear and avoidance: a recent survey study. *JADA* 1983; 107(4):609-610.
15. Milsom KM, Tickle M, Humphris GM, Blinkhorn AS. The relationship between anxiety and dental treatment experience in 5-year-old children. *Br Dent J*. 2003; 194(9):503-6.
16. Hagglin C, Hakeberg M, Ahlqwist M, Sullivan M, Berggren U. (2000). Factors associated with dental anxiety and attendance in middle-aged and elderly women. *Commun Dent Oral Epidemiol*, 28(6), 451-460.

17. Quteish Taani DS. Dental anxiety and regularity of dental attendance in younger adults. *J Oral Rehabil.* 2002; 29: 604-8.
18. Rousset C, Lambin M, Manas F. The ethological method as a means for evaluating stress in children two to three years of age during a dental examination. *ASDC J Dent Child.* 1997; 64(2):99-106.
19. Milgrom P, Mancl L, King B, Weinstein P. Origins of childhood dental fear. *Behav Res Ther.* 1995; 33(3):313-9.
20. Armfield JM, Stewart JF, Spencer AJ. The vicious cycle of dental fear: exploring the interplay between oral health, service utilization and dental fear. *BMC Oral Health.* 2007; 7:1.
21. Schuller A, Willumensen T, Holst D. Are there differences in oral health and oral health behavior between individuals with high and low dental fear? *Community Dent Oral Epidemiol.* 2004; 32:116-121.
22. Alvesalo I, Murtomaa H, Milgrom P, Honkanen A, Karjalainen M, Tay MK. The dental fear study survey schedule: a study with Finnish children. *Int J Paediatr Dent.* 1993; 3: 293–300.
23. Milgrom P, Fiser L, Melnick S, Weinstein P. The prevalence and practice management consequences of dental fear in a major US city. *J Am Dent Assoc.* 1988; 116: 641–647.
24. Locker D, Liddell A. Clinical correlates of dental anxiety among older adults. *Commun Dent Oral Epidemiol.* 1992; 20: 372-5.
25. Mehrstedt M, Tonnies S, Eisentraut I. Dental fears, health status, and quality of life. *Anesth Prog* 2004; 51(3):90-94.
26. Davila JM, Menendez J. Relaxing effects of music in dentistry for mentally handicapped patients. *Spec Care Dentist.* 1986; 6(1):18-21.
27. Shapiro M, Melmed RN, Sgan-Cohen HD, Eli I, Parush S. Behavioural and physiological effect of dental environment sensory adaptation on children's dental anxiety. *Eur J Oral Sci.* 2007; 115(6):479-83.
28. Bare LC, Dundes L. Strategies for combating dental anxiety. *J Dent Educ.* 2004 Nov; 68(11):1172-7.
29. Arntz A, van Eck M, Heijmans M. Prediction of dental pain: the fear of any expected evil, is worse than the evil itself. *Behav Res Ther.* 1990; 28(1):29-41.
30. Klages U, Kianifard S, Ulusoy O, Wehrbein H. Anxiety sensitivity as predictor of pain in patients undergoing restorative dental procedures. *Community Dent Oral Epidemiol.* 2006; 34(2):139-145.
31. Eli I, Schwartz-Arad D, Baht R, Ben-Tuvim H. Effect of anxiety on the experience of pain in implant insertion. *Clin Oral Implants Res.* 2003; 14(1):115-118.
32. Wardle J. Fear of dentistry. *Br J Med Psychol.* 1982; 55(pt 2):119-126.
33. Cohen SM, Fiske J, Newton JT. The impact of dental anxiety on daily living. *Br Dent J.* 2000; 189: 385-90.
34. Moore R, Birn H, Kirkegaard E, Brødsgaard I, Scheutz F. Prevalence and characteristics of dental anxiety in Danish adults. *Commun Dent Oral Epidemiol.* 1993; 21: 292-6.
35. Eitner S, Wichmann M, Paulsen A, Holst S. Dental anxiety - an epidemiological study on its clinical correlation and effects on oral health. *J Oral Rehabil.* 2006; 33: 588- 93.

36. Aitken JC, Wilson S, Coury D, Moursi AM. The effect of music distraction on pain, anxiety and behavior in pediatric dental patients. *Pediatr Dent*. 2002; 24(2):114-8.
37. Soh G. Effects of explanation of treatment procedures on dental fear. *Clin Prev Dent*. 1992; 14(1):10-13.
38. Moore PA, Ramsay DS, Finder RL, Laverick W. Pharmacologic modalities in the management and treatment of dental anxiety. *Dent Clin North Am*. 1988; 32(4):803-816.
39. Elmore AM. Biofeedback therapy in the treatment of dental anxiety and dental phobia. *Dent Clin North Am*. 1988; 32(4):735-744.
40. Forgiione AG. Hypnosis in the treatment of dental fear and phobia. *Dent Clin North Am*. 1988; 32(4):745-761.
41. Kvale G, Berggren U, Milgrom P. Dental fear in adults: a meta analysis of behavioral interventions. *Community Dent Oral Epidemiol*. 2004; 32(4):250-264.
42. Aartman IH, de Jongh A, Makkes PC, Hoogstraten J. Dental anxiety reduction and dental attendance after treatment in a dental fear clinic: a follow-up study. *Community Dent Oral Epidemiol*. 2000; 28(6):435-442.
43. Halvorsen B, Willumsen T. Willingness to pay for dental fear treatment: is supplying dental fear treatment socially beneficial? *Eur J Health Econ*. 2004; 5(4):299-308.
44. Hainsworth JM, Moss H, Fairbrother KJ. Relaxation and complementary therapies: an alternative approach to managing dental anxiety in clinical practice. *Dent Update*. 2005; 32: 90-2, 4-6.
45. Dileo CD, Bradt J. *Medical music therapy: A meta-analysis & agenda for future research*. Jeffrey Books, 2005.
46. Mok E, Wong KY. Effects of music on patient anxiety. *AORN Journal* 2003; 77(2):396-9.
47. Hamel WJ. The effects of music intervention on anxiety in patients waiting for cardiac catheterization. *Intensive Crit Care Nurs*. 2001; 17:279-85.
48. Pfaff VK, Smith KE, Gowan D. The effects of music assisted relaxation on the distress of pediatric cancer patients undergoing bone marrow aspiration. *Child Health Care*. 1989; 18:232-6.
49. Olszewska I, Zarow M. Does Music during a dental treatment make a difference? *J Dent Res*. 2003; 82: B-351.
50. Dunne J. Music Therapy. *Psychiatr Bull*. 1990; 14: 285-286.
51. Your Dictionary Online. *Websters New World College Dictionary*. Wiley Publishing, Inc., Cleveland, Ohio; 2010 [cited 2010 June 4]. Available from <http://www.yourdictionary.com/music>.
52. Parkin SF. The effect of ambient music upon the reactions of children undergoing dental treatment. *ASDC J Dent Child*. 1981 Nov-Dec; 48(6):430-2.
53. Bonny H. Music and healing. *Music Ther*. 1986; 6: 3–12.
54. Gfeller K. Music therapy in the treatment of medical conditions. In: Davis WB, Gfeller KE, Thaut MH, eds. *An Introduction to Music Therapy and Practice*. Dubuque, IA: WC Brown, 1992; 234– 50.
55. Guzzetta C. Music therapy: nursing the music of the soul. In: Campbell D, ed. *Music Physician for Times to Come*. Wheaton, IL: Quest Books, 1991, 146–66.

56. Australian Music Therapy Association [homepage on the internet]. Australia; 2010. [cited 2010 June 4]. Available from <http://www.austmta.org.au/about/frequently-asked-questions/#therapy>.
57. Klassen JA, Liang Y, Tjosvold L, Klassen TP, Hartling L. Music for pain and anxiety in children undergoing medical procedures: a systematic review of randomised controlled trials. *Ambul Pediatr*. 2008; 8(2):117-128.
58. Gillen E, Biley F, Allen D. Effects of music listening on adult patients' pre-procedural state anxiety in hospital. *Int J Evid Based Healthc*. 2008 Mar; 6(1):24-49.
59. Bruscia KE. *Defining Music Therapy*, 2nd edn. Gilsum, NH: Barcelona Publishers, 1998.
60. Munro, S. & Mount, B. Music therapy in palliative care. *Can Med Assoc J*. 1978; 119: 1029-1034.
61. Metzler, R.K., "Music Therapy at the Behavioral Learning Center," *St. Paul Public School, J Music The*. 1973; 10: 177- 183.
62. Cook J. The therapeutic use of music: a literature review. *Nurs Forum*. 1981; 20 (3): 252-266.
63. Goff LC, Pratt RR, Madrigal JL. Music listening and S-IgA levels in patients undergoing a dental procedure. *Int J Arts Med*. 1997; 5(2):22-6.
64. Kyoung Kim Y, Kim SM, Myoung H. Musical Intervention Reduces Patients' Anxiety in Surgical Extraction of an Impacted Mandibular Third Molar. *J Oral Maxillofac Surg*. 2010; 69 (4): 1036-45.
65. Steven K. Patients' perception of music during surgery. *J Adv Nurs*. 1990; 15: 1045.
66. Snyder M, Lindquist R. *Complementary/Alternative Therapies in Nursing* (ed 5). 2006. New York, Springer.
67. Wigram T, Pederson IN, Bonde LO. *A Comprehensive Guide to Music Therapy*. London: Jessica Kingsley, 2002; 134–9.
68. Allen J, Good M. Music during crisis. *Am J Nurs*. 2000; 100: 24AA–24CC.
69. Steelman VM: Intraoperative music therapy: Effect on anxiety, blood pressure. *AORN J*. 52:1026, 1990.
70. Marwick, Charles. Leaving concert hall for clinic, therapists now test music's charms. *JAMA*. 1996; 275 (4): 267-8.
71. Frankl SN, Shiere FR, Fogels HR. Should the parent remain with the child in the dental operatory? *ASDC J Dent Child*. 1962; 29:150-63.
72. Winer GA. A review and analysis of children's fearful behavior in dental settings. *Child Dev*. 1982; 53(5):1111-33.
73. Venham L, Bengston D, Cipes M. Children's response to sequential dental visits. *J Dent Res*. 1977; 56(5):454-9.
74. Corah NL. Development of a dental anxiety scale. *J Dent Res*. 1969; 48(4):596.
75. Wong HM, Humphris GM, Lee GT. Preliminary validation and reliability of the Modified Child Dental Anxiety Scale. *Psychol Rep*. 1998; 83(3 Pt 2):1179-86.
76. Howitt JW, Stricker G. Child patient response to various dental procedures. *J Am Dent Assoc*. 1965; 70:70-4.

77. Lai H, Hwang M, Chen C, Chang K, Peng T, Chang F. Randomised controlled trial of music on state anxiety and physiological indices in patients undergoing root canal treatment. *J Clin Nurs*. 2008; 17(19):2654-60.
78. Moola S, Pearson A, Hagger C. The effectiveness of music interventions on dental anxiety in paediatric and adult patients – A systematic review. *JBI Library of Systematic Reviews*. 2010; 9 (18): 588-630.
79. Marwah N, Prabhakar AR, Raju OS. Music distraction - Its efficacy in management of anxious pediatric dental patients. *J Indian Soc Pedod Prev Dent*. 2005; 23(4):168-70.
80. Clarke M, Oxman AD. *Cochrane Reviewers Handbook*. 4.14. The Cochrane Library, Issue 4: 2001. Accessed 16 August 2006. Available from: <http://www.cochrane.org>.
81. Klein SA, Winkelstein ML. Enhancing paediatric health care with music. *J Paediatr Health Care*. 1996; 10 (2): 74-81.
82. Buffum MD, Sasso C, Sands LP, Lanier E, Yellen M, Hayes A. A music intervention to reduce anxiety before vascular angiography procedures. *J Vasc Nurs*. 2006; 24: 68–73.
83. Baghdadi ZD. Evaluation of audio analgesia for restorative care in children treated using EDA. *J Clin Ped Dent*. 2000; 25: 9-12.
84. Brand HS, Gortzak R, Palmer-Bouva CC, Abraham RE, Abraham Inpijn L. Cardiovascular and neuroendocrine response during acute stress induced by different types of dental treatment. *Int Dent J*. 1995; 45:45.
85. Kabak Y, Abbott PV. Prevalence of apical periodontitis and the quality of endodontic treatment in an adult Belarusian population. *Int Endod J*. 2005; 38: 238–45.
86. Hayes A, Buffum M, Lanier E, Rodahl E, Sasso C. A music intervention to reduce anxiety prior to gastrointestinal procedures. *Gastroenterol Nurs* 2003; 26: 145–9.
87. Lai HL, Good M. An overview of music therapy. *J Nurs*. 2002; 49: 80-84.
88. Wang S, Kulkarni L, Dolev J, Kain ZN. Music and preoperative anxiety: a randomised controlled study. *Anesth Analg*. 2002; 94: 1489–94.
89. Cooke M, Chaboyer W, Schluter P, Hiratos M. The effect of music on preoperative anxiety in day surgery. *J Adv Nurs*. 2005; 52: 47–55.
90. Silberstein CM. Sone-aural dentistry. An overview. *J Am Analg Soc*. 15: 6-10, 1972.

References to excluded citations

1. Gatchel RJ. Increasing dental patients' access to measures for anxiety, fear, and phobia management. Perspectives from a community-based research program. *Anesth Prog*. 1986 Jan-Feb; 33(1):67-9.
2. Little JW. Complementary and alternative medicine: impact on dentistry. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2004 Aug; 98(2):137-45.
3. Parkin SF. The effect of ambient music upon the reactions of children undergoing dental treatment. *ASDC J Dent Child*. 1981 Nov-Dec; 48(6):430-2.
4. Satoh Y, Nagai E, Kitamura K, Sakamura M, Ohki K, Yokota S, et al. Relaxation effect of an audiovisual system on dental patients. Part 2. Palus-amplitude. *J Nihon Univ Sch Dent*. 1995 Sep; 37(3):138-45.
5. Tecavec C. Calming patients: DA tapes songs to relax children. *Dent Assist (Waco Tx)*. 1982 Jan-Feb; 1(3):6-7.
6. Vinard H, Ravier-Rosemblaum C. The psychosomatic effect of the sonic environment in the dental office. *Rev Odontostomatol (Paris)*. 1989 Mar-Apr; 18(2):101-8.
7. White PF. Use of alternative medical therapies in the perioperative period: Is it time to get on board? *Anaesth Analg*. 2007; 104(2):251-4.
8. Gaberson KB. The effect of humorous and musical distraction of preoperative anxiety. *AORN J*. 1995; 62(5):784.
9. Heiser RM, Chiles K, Fudge M, Gray SE. The use of music during the immediate postoperative recovery period. *AORN J*. 1997; 65(4):777.
10. Szeto CK, Yung PMB. Introducing a music programme to reduce preoperative anxiety. *Br J Theat Nurs*. 1999; 9(10):455.
11. Cohen BE. Use of aromatherapy and music therapy to reduce anxiety and pain perception in dental hygiene. *Access*. 2001; 15(6):34.
12. Ikonomidou E, Rehnström A, Naesh O. Effect of music on vital signs and postoperative pain. *AORN J*. 2004; 80(2):269.
13. Cooke M, Chaboyer W, Schluter P, Hiratos M. The effect of music on preoperative anxiety in day surgery. *J Adv Nurs*. 2005; 52(1):47-55.
14. Podder L. Effects of music therapy on anxiety levels and pain perception. *Nurs J India*. 2007; 98(7):161.
15. Hook L, Sonwathana P, Petpichetchian W. Music therapy with female surgical patients: effect on anxiety and pain. *Thai J Nurs Res*. 2008; 12(4):259-71.
16. Goldin L. Anxiety reduction through humorous audiotapes in pediatric dental patients. US: ProQuest Information & Learning; 1994.
17. Prabhakar AR, Marwah N, Raju OS. A comparison between audio and audiovisual distraction techniques in managing anxious pediatric dental patients. *J Indian Soc Pedod Prev Dent*. 2007; 25 (4): 177-82.

18. Cirina CL. Effects of sedative music on patient preoperative anxiety. *Today's OR nurse*. 1994; 16(3):15-8.
19. Davila JM, Menendez J. Relaxing effects of music in dentistry for mentally handicapped patients. *Spec Care Dentist*. 1986 Jan-Feb; 6(1):18-21.
20. Filcheck H, Allen KD, Ogren H, Darby JB, Holstein, B and Hupp S. The use of choice-based distraction to decrease the distress of children at the dentist. *Child Fam Behav Ther*. 2005; 26(4):59-68.
21. Bare LC, Dundes L. Strategies for combating dental anxiety. *J Dent Educ*. 2004 Nov; 68(11):1172-7.
22. Bekhuis T. Music therapy may reduce pain and anxiety in children undergoing medical and dental procedures. *J Evid Based Dent Pract*. 2009; 9(4):213-4.
23. Evans D. The effectiveness of music as an intervention for hospital patients: a systematic review. *J Adv Nurs*. 2002; 37(1):8-18.
24. Jorm AF, Christensen H, Griffiths KM, Parslow RA, Rodgers B, Blewitt KA. Effectiveness of complementary and self-help treatments for anxiety disorders. *Med J Aust*. 2004 Oct 4; 181(7 Suppl):S29-46.
25. Klassen JA, Liang Y, Tjosvold L, Klassen TP, Hartling L. Music for pain and anxiety in children undergoing medical procedures: a systematic review of randomized controlled trials. *Ambul Pediatr*. 2008 Mar-Apr; 8(2):117-28.
26. Tran D, Edenfield SM, Coulton K, Adams D. Anxiolytic intervention preference of dental practitioners in the Savannah, Chatham County area: a pilot study. *J den hyg: JDH / American Dental Hygienists' Association*. 2010; 84(3):151-5.
27. Olszewska I ZM. Does Music during a Dental Treatment Make a Difference? *J Dental Res*. 2003; 82: Special Issue B June.