A Comprehensive Analysis of the Evidence on Non-pharmacological Interventions in the Management of Dental Anxiety: A Linked Series of Systematic Reviews

Contents

Abstract

Background: 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 anxiety and in children the prevalence estimates range between 5.7% and 19.5%. Patients with dental anxiety tend to neglect dental care which poses a problem for both dentists and patients. Dental anxiety has long been recognised as a source of serious problem in providing dental services to the patients. Terms such as dental fear, dental phobia, and dental anxiety are often used synonymously and do not have agreed clinical definitions. Dental anxiety leading to avoidance of dental treatment is common and appears to be associated strongly with clinically significant deterioration of oral and dental health. Pain or fear of pain is a known primary source of anxiety, as well as a major obstacle to seeking dental care. Dental injection was found to be the most powerful anxiety-provoking stimulus, followed by the dental drill and the sight and sensation of a dental local anaesthetic injection.

Strategies for managing dental anxiety include, but are not limited to: explanation of the treatment procedure, pharmacological strategies involving the use of benzodiazepines and antidepressants, biofeedback, hypnosis, behavioural interventions and relaxation. 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. Behavioural management is found to be superior to anxiolytic drug therapy, and dentally anxious patients report that they prefer nonpharmacological interventions. No comprehensive systematic reviews exist encompassing all pharmacological nonpharmacological managements for dental anxiety in paediatric and adult patients undergoing various dental treatments/procedures in various dental settings. The series of reviews aimed to identify and synthesise the best available evidence on all nonpharmacological interventions for managing dental anxiety in paediatric and adult patients in dental situations.

Objectives: The overall objective of this series of systematic reviews was to identify and synthesise the best available effective, meaningful and/or appropriate evidence on all non-pharmacological interventions in the management of DA and dental fear in paediatric and adult patients.

Review methods: The series of systematic reviews included both paediatric patients from any young age and adult patients of all age groups. The reviews excluded people with special needs and disabled people. All nonpharmacological interventions were examined. The primary outcome of interest was dental anxiety and other outcomes such as pain, dental avoidance and satisfaction were only reported if data on dental anxiety was reported. All types of study designs were considered for inclusion in the review.

Results: Overall, 288 studies were included in the series of reviews that examined various nonpharmacological interventions. There was moderate to strong evidence for interventions such as aromatherapy, atraumatic restorative treatment, audiovisual including music and imagery, behaviour management techniques, utilisation of new technology, hypnosis and cognitive behaviour therapy. Most of the behaviourally oriented treatments included components based on systematic desensitisation, modelling, guided imagery and use of relaxation to weaken the fear response during gradual exposure to treatment and alleviate dental anxiety. Dental anxiety management should be considered an integral part of clinical practice, as the prevalence is high but goes unrecognised. Interventions should be tailored according to patients' needs considering their degree of anxiety, age, and cooperation. In addition, dentists should take into account their own experience and expertise, and the clinical context. Overall, patients with mild to moderate dental anxiety can be nonpharmacologically managed using various psychotherapeutic interventions. However, in cases of high levels of dental anxiety and/or dental phobia a combination of nonpharmacological management approaches can be utilised.

Implications for practice: Based on the available evidence, a summary of recommendations is provided along with clinical decision making algorithms to manage dental anxiety in patients.

Implications for research: Reviewed evidence suggests that there is no need to conduct further studies on the majority of the interventions as there is enough evidence base to support their use. However, research on the feasibility aspect is lacking for many of these interventions and there is a lack of research in this field on how to implement these interventions in time poor settings as some of the advanced nonpharmacological techniques require time, effort, training and involve costs both to the dental practitioner and the patient.

Thesis Declaration

I certify that this work contains no material that has been accepted for the award of any other degree or diploma in any university or other tertiary institution 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 acknowledged in the text.

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Sandeep Moola Date: 02/11/2017

Acknowledgments

I would like to acknowledge my Principal Supervisor, Emeritus Prof Alan Pearson who has always encouraged and motivated me to complete my PhD. I would also like to thank him for his expert overview.

I would like to thank my Co-supervisors, Dr Gloria Mejia and Assoc Prof Jason Armfield for their valuable feedback, input and time.

My sincere thanks to the Joanna Briggs Institute (JBI), University of Adelaide for providing me this opportunity and support for completing for my PhD.

Lastly, but most importantly, I would like to thank my wife, Priyanka without whose support, patience and constant encouragement, I wouldn't have completed my PhD. My 15-month old daughter, Naomika, who's been a bundle of joy and the source of my motivation to complete my PhD, especially in my last year of candidature. To my parents, Mr Gnaneshwar Goud and Mrs Vinodini, without whom I wouldn't have got this opportunity. And finally a big thank you to God!

1. Introduction to the Program of Research

1.1. Introduction

My Principal Supervisor Emeritus Prof Alan Pearson AM always emphasised that the "PhD is not a 'Nobel' prize work"! I should have probably realised earlier in my candidature that the statement was probably true and yes, I now fully understand why my Prof said that. The idea for this thesis emerged out of my Master's degree work that involved conducting a systematic review to examine the effectiveness of music interventions in reducing dental anxiety (DA). Following completion of the systematic review, I enrolled in the PhD program to potentially explore the evidence out there on all strategies/interventions to manage and reduce DA through the conduct of multiple or a linked series of systematic reviews, then develop guidelines in consultation with clinical dental experts and finally, based on the guidance provided, develop and validate an app that would complete the whole cycle of evidence synthesis, evidence transfer/dissemination and evaluation, which very much fits in with the Joanna Briggs Institute's (JBI) model of evidence based health care (EBHC). It was a lofty ambition to work through the three phases within my limited PhD candidature time and after a few months into my candidature, I realised that this would be impossible to complete.

The literature on interventions/strategies to manage and reduce DA in patients, both children and adults was extensive and exhaustive, the synthesis of which would take considerable time. Therefore, a revised proposal was submitted to conduct a linked series of systematic reviews that examined the feasibility, appropriateness, effectiveness and meaningfulness (JBI FAME approach) of various non-pharmacological interventions in managing and reducing patient DA. It was intended that following the completion of my PhD program, another linked series of systematic reviews would be undertaken to examine the FAME of various pharmacological interventions. Overall, my PhD journey was a rollercoaster ride! In the end, the thesis was never meant to be a comprehensive EBHC resource; rather, it was meant to be a reasonably coherent and succinct contribution to the knowledge related to a segment of an important topic in the dental and oral health field!

This chapter describes the EBHC concept, introduces the systematic review and its emerging methodologies and then explains how this evidence synthesis approach is

useful in the DA research area. Evidence based medicine (EBM), the original concept proposed by Sackett et al[1], is defined as "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients; in other words, "integrating individual clinical expertise with the best available external clinical evidence from systematic research."[p. 71] The development of EBM has been rapid since its emergence in the early 1990s and has primarily been led by Professor David Sackett of the University of Oxford. The term 'Evidence based' has evolved beyond its initial use in the field of medicine and underlying medical practice. The term now denotes who the end user of the 'Evidence' is - beyond medicine and this includes dentists, nurses, policy makers, physiotherapists, occupational therapists, psychologists, and the list goes on! Evidence based health care includes all facets of health care and, therefore, is widely known variously as EBM, evidence based practice (EBP), evidence based dentistry (EBD), and evidence based nursing (EBN).

The dominant approach to the systematic review of evidence favours the meta-analysis of the results of randomised controlled trials (RCTs), as the RCT is conceptualised as the "gold standard" in evidence of effectiveness, with other quantitative methods ranked as lower in quality in terms of evidence, and the results of interpretive and critical research have not, until very recently, been regarded as high quality evidence.[2] Most health professions are increasingly embracing the concept of EBP and many use evidence based guidelines to inform practice. Although medicine and nursing are the health care occupations most advanced in the EBP movement, the ideas and arguments are common to all professionals who work in health care including dentistry and oral health.

Pearson et al stated that EBP should consider the best available evidence, the context in which the care is delivered, clinician's knowledge and expertise, and the preferences of the patient.[2] It is important that each factor is considered when making decisions about the care and treatment of a patient. Jordan et al stated that for health professionals to be able to establish the utility of a broad range of interventions and procedures, a broad conceptualisation of evidence is needed and while evidence of effectiveness is acknowledged as being of value, other types of evidence should be considered to answer different clinical questions.[3] The JBI regards the results of well-designed research studies grounded in any methodological position as providing more vigorous evidence than anecdotes or personal opinion.

The approach to evaluating evidence must be tailored to the specific focus of the review; and the development and peer review of a protocol is fundamental to undertaking systematic reviews. Given the explosion of knowledge and access to a diverse range of knowledge sources over the past decade, it is now almost impossible for individual clinicians or clinical teams to stay abreast of knowledge in a given field. A systematic review, conducted by review groups with specialised skills, sets out to retrieve international evidence and to translate the results of this search into various evidence based resources in an appropriate and a suitable format for the transfer of knowledge into practice settings. Hence, the systematic review process is also referred to as a research synthesis.

Systematic reviews underpin EBHC. The process of conducting a systematic review is a scientific exercise, and as the results will influence health care decisions, it is essential to have the same rigour expected of all research. The quality of a review depends on the extent to which scientific review methods are followed to minimise the risk of error and bias. The explicit and rigorous methods of the process distinguish systematic reviews from traditional reviews of the literature. One of the biggest challenges within scientific research is to interpret the results of individual studies in the context of other research that has been done. This is especially important for decisions about whether an intervention works and for decisions about what further studies should be done. For example, if a recent small study appeared to show that a treatment worked or a substance caused harm, but previous good-quality studies had concluded the opposite, these results need to be looked at together. Systematic reviews can: end confusion; highlight where there is not enough evidence; yield new insights by combining findings from different studies; show when enough evidence has been produced; and reduce the influence of any flaws or errors in a single study. The advantages of systematic reviews include: reduction in bias; replicability; the resolution of controversy between conflicting findings; and providing a reliable basis for decision making.

A systematic review uses transparent procedures to find, evaluate and synthesise the results of relevant research. Procedures are explicitly defined in advance, in order to ensure that the exercise is transparent and can be replicated. This practice is also designed to minimise bias. Studies included in a review are screened for quality, so that the findings of a large number of studies can be combined. Peer review is a key part of the process; qualified independent researchers control the review author's methods and

results. The purpose of a systematic review is to sum up the best available research on a specific question and this is done by synthesising the results of several studies. A systematic review is characterised by: a clearly stated set of objectives with pre-defined eligibility criteria for studies; an explicit, reproducible methodology; a systematic search that attempts to identify all studies that would meet the eligibility criteria; an assessment of the validity of the findings of the included studies; and a systematic presentation, and synthesis, of the characteristics and findings of the included studies.

The randomised controlled trial is probably considered to be the best approach to generating evidence of effectiveness; however, dentists, nurses, medical practitioners and other health professionals are concerned with more than cause and effect questions, and this is reflected in the wide range of research approaches utilised in the health field to generate knowledge for practice. Evidence based healthcare does not eliminate the need for reasoning and reflection by the clinician; on the contrary, the clinician requires enhanced clinical reasoning skills when deciding on what evidence and/or recommendations to follow. It is not so simple when a patient refuses or cannot be treated with the intervention supported in the evidence, although it is obviously the best course of treatment as 'even excellent external evidence may be inapplicable to or inappropriate for an individual patient' (Sackett 1996, pg. 71-72).[(1)] It is also important to ensure that the EBHC recommendations are taken into clinical consideration, as by ignoring them a potentially harmful or less effective intervention may be carried out whilst a more effective intervention is available.

A meta-analysis is a statistical procedure which combines the findings from multiple primary studies into a single overall summary estimate. A meta-analysis can be conducted to improve statistical power to detect a treatment effect; to estimate a summary average effect; to identify sub-groups associated with a beneficial effect; and to explore differences in the size or direction of the treatment effect associated with study-specific variables. It is an integral part of the systematic review, however it does not represent all steps in the process. A meta-analysis is simply the statistical combination of results from studies – the final estimate of effect may not always be the result of a systematic review of the literature. Therefore, it should not be considered as a type of review.

When conducting a meta-analysis, it is essential to understand the two underlying statistical assumptions; fixed effects (based on the assumption that there is one true effect underlying the included studies and studies are homogenous) or random effects (based on the assumption that there could be other factors both within and across studies that may influence the data other than chance).[4] Heterogeneity refers to the amount of variation in the characteristics of the included studies; i.e. when there are significant differences between studies.[5]

Egger et al[6] suggest different statistical methods for combining data and emphasised that there is not one appropriate method.[4] Study type, the nature of the data extracted and the assumptions underlying the meta-analysis determine the type of technique.[4] Egger et al[6] recommend undertaking a sensitivity analysis to determine the robustness of combined estimates to different assumptions, methods and inclusion criteria as well as examining the possible influence of bias.[4]

According to Pearson et al, meta-synthesis is another form of synthesis that involves the pooling of textual information. The term meta-synthesis refers to a higher form of synthesis, or could be termed the 'science of summing up'.[7] It is the process of combining the findings of individual qualitative studies to create summary statements that authentically describe the meaning of these themes. Like meta-analysis, meta-synthesis is an integral part of the systematic review, however does not represent all steps in the process. Qualitative research can be used in a variety of contexts to inform and improve EBP and therefore should not be considered just as an alternative approach to quantitative research. The findings from qualitative research can work well in conjunction with findings from quantitative studies to provide answers to different clinical questions. A mixed method or comprehensive systematic review gathers both forms of evidence that is qualitative and quantitative evidence regarding FAME. Separate analyses and synthesis are performed on the corresponding data.

1.2. What does this thesis add?

Definition, clinical features, and classifications

- What is the definition of dental anxiety as a symptom/syndrome?
- What is the definition of dental anxiety as a specific clinical profile?

- How is dental anxiety classified?

Non-pharmacological treatment

- What are the most effective non-pharmacological treatment approaches for managing dental anxiety including dental fear and dental phobia in patients undergoing various dental procedures?

Information/communication with patients

- What is the basic information that should be given to patients with dental anxiety

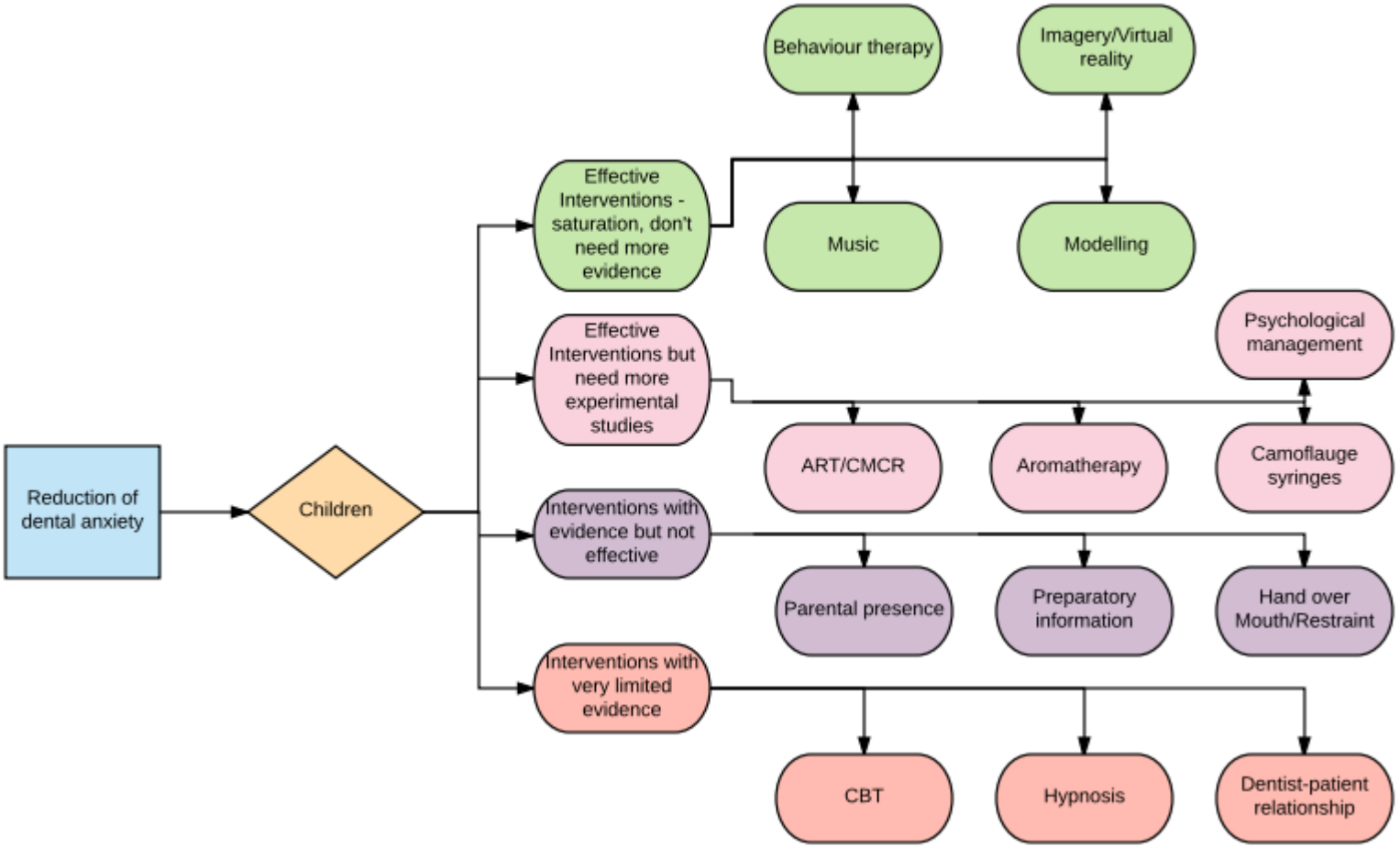


Figure 1. Evidence map showing the effective and non-effective nonpharmacological interventions in the reduction of dental anxiety in paediatric patients

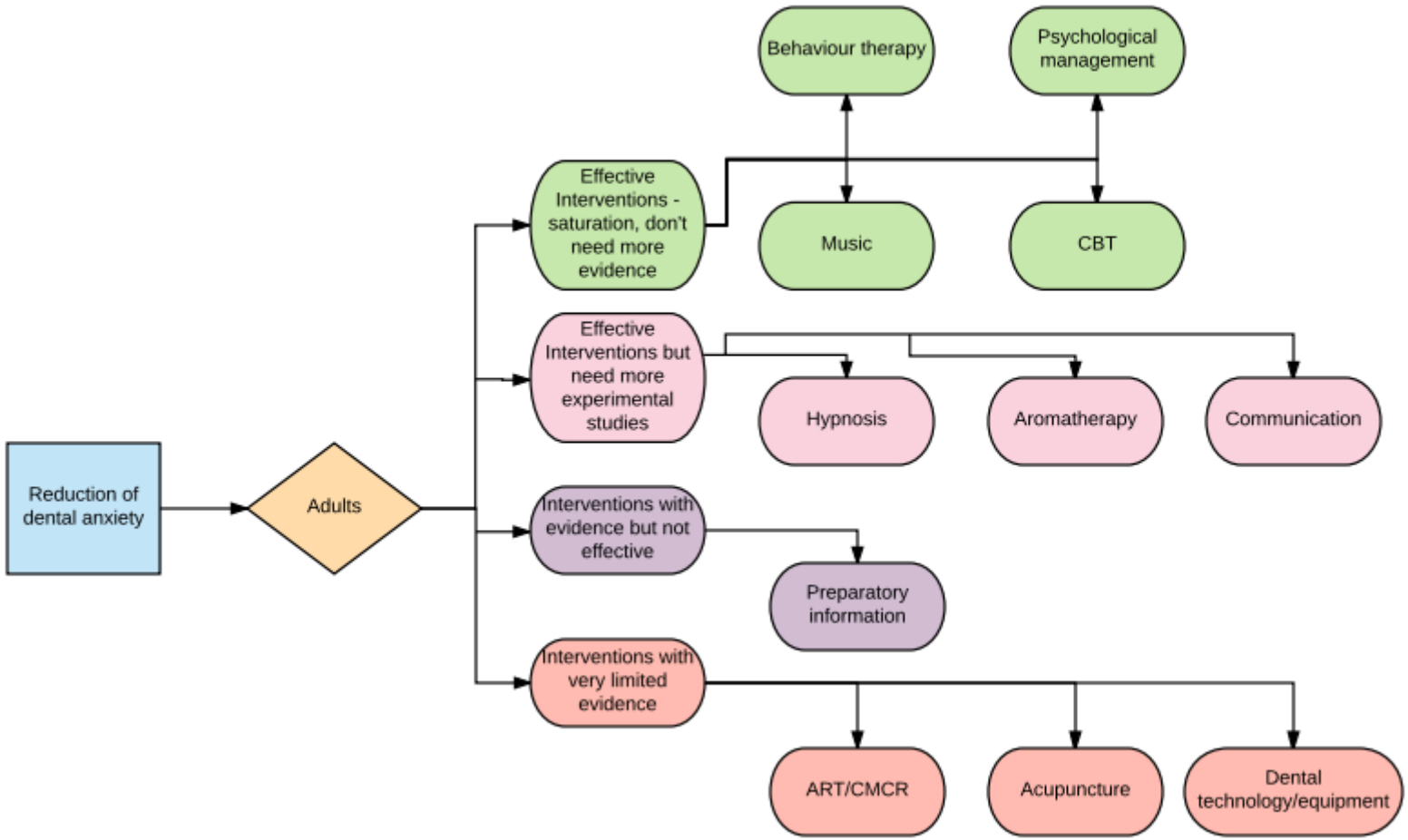


Figure 2. Evidence map showing the effective and non-effective nonpharmacological interventions in the reduction of dental anxiety in adult patients

1.3. Information for the patient

How is dental anxiety diagnosed?
Your dental care professional will use different tools to be able to establish the diagnosis of your dental anxiety.

- Clinical History: the dental care professional will ask you about any family history of dental anxiety.
- Physical examination: helps your dentist or dental hygienist to know whether your symptoms are caused by something other than dental anxiety.
- Questionnaires: your dental care centre may use a specific questionnaire to help in the diagnosis or to see the changes that are experienced over time.

What are the treatment options?
There are several objectives of the treatment of your anxiety problem:

- Alleviate dental anxiety and prevent any relapse.
- To reduce their frequency, duration, and intensity, and reduce avoidance behaviour.

The usual nonpharmacological treatments are psychotherapy, audiovisual, aromatherapy, and CBT, which may or may not be used together, depending on the severity of dental anxiety that you have and the type of dental procedure.

What should I keep in mind when I visit my dental health professional?
It is important that the anxiety and fear that is associated with dental procedures does not prevent you from seeking professional dental help. Visit your dental care centre/clinic. The following are some useful tips for your next visit to your dentist or a dental hygienist or a dental therapist.

- You can trust the professionals at the dental clinic. They will understand your dental anxiety and fear.
- Prepare what you want to say to the doctor beforehand. - Tell your doctor your physical and emotional symptoms. It may be helpful if a family member accompanies you. - Don't be afraid to ask any questions that are still unclear to you.
- It is essential that you express your preferences in regard to the different treatment options.

Keep in mind that you are the most important part of this process.

How can I handle my dental anxiety?

- If you are doing psychotherapy, at home, it is important to practice the exercises learned in therapy, such as relaxation and breathing, because they will be of great use to you.
- Try to leave space every day to include activities that will be enjoyable and fun among your tasks: listen to music and anything that is relaxing for you.
- Learn to handle your feelings. Positive thoughts also have a positive effect on your mood.
- Lastly, remember that you can learn to control anxiety and reduce it progressively.

Where can I learn more about dental anxiety?
Dental organisations, associations of patients and families and dental anxiety support groups

2. Background to the program of research

2.1. Dental Anxiety

Dental anxiety has been identified as a significant and common problem in both children and adults and is considered an obstacle to the provision of quality dental care by dental care providers.[8] Patients with DA tend to avoid dental care which poses a problem for both dentists and patients.[8] Fear of dental treatment that might result in poor oral health is recognised as a public health concern.[9] In addition, DA has long been recognised as a source of serious problem in providing dental services to patients.[10] Dental anxiety leading to avoidance of dental treatment is common and appears to be associated strongly with clinically significant deterioration of oral and dental health.[11, 12]

Dental anxiety is a fear of the unknown or a state of apprehension in relation to dental treatment, usually an unknown or potential future threat; dental fear (DF) is a reaction to one or more specific threatening stimuli in a dental situation; and dental phobia (DP) is an extreme form of DA characterised by persistent anxiety to specific stimuli or in general to a dental situation.[13] Terms such as dental anxiety, dental fear, and dental phobia are often used interchangeably or synonymously in the dental literature without any agreed or acceptable clinical definitions or are largely disregarded in the literature.[14] Dental anxiety including severe DA is commonly defined by the use of cut-off points on validated self-reported scales and dental phobia denotes individuals with a behaviour pattern of avoidance of dental care, usually defined according to criteria in psychiatric manuals.[15] Dental phobia is classified as a Specific Phobia (300.29) in the Diagnostic and Statistical Manual of Mental Disorders.[16]

Severe dental fear and dental phobia differ in relation to their impact on normal functioning.[17] When avoidance, anxious anticipation or distress in the feared situations interfere significantly with the person's normal routine, occupational (or academic) functioning, or social activities or relationships, or if there is a marked distress about having the phobia, then it is classified as phobia.[17] For the purposes of easier understanding and consistency and unless it is necessary and relevant to specify, the term dental anxiety (DA) is used throughout this thesis to refer to both dental fear (DF) and dental phobia (DP).

2.2. Prevalence of dental anxiety

It is reported that in children the prevalence ranges between 5.7% and 19.5% and one in six adults suffer from some form of DA.[8] Overall, the prevalence of DA ranges between 4 and 20 percent.[18-20] In a survey undertaken in England in five year old children with DA, it was found that there were statistically significant high rates of carious teeth.[21] Bernson et al found that 2–3% showed phobic avoidance or reported irregular dental care.[22] In the general population, the prevalence of severe DA including DP has been reported to be approximately 5%.[15]

In a survey conducted in 1996 in Australia, it was reported that 14.9% of adults were classified as highly dentally anxious.[23] One survey found that nearly two thirds of dentists believed that treating an anxious patient presented a challenge to them in everyday practice.[24] The 2004-06 National Survey of Adult Oral Health conducted in Australia found that infrequent dental attendance in the Australian population was significantly associated with financial barriers and DA; the population-level effects were however small.[25]

The reported DA prevalence across various studies shows that it is a significant problem for both dental health care workers and patients. Bray et al[14] reported that anxious patients require more chair time and frequently cancel scheduled appointments and therefore dentists regard anxious patients as a great source of professional stress. Studies showed that when compared to relaxed patients, dentally anxious patients often avoid dental visits for long periods or avoid dental services altogether.[26, 27] 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.[28]. Dental anxiety is also considered as a potential predictor of dental caries incidence.[29]

Hmud et al reported that the prevalence of DA reduces with age; however, they also found that few other studies did not show a strong association of DA with age.[8] In addition, the relationship between DA and other demographic variables such as income level and education (socioeconomic status) is not clear. One study found that females aged between 30-45 years were particularly dentally anxious[23] while another found a high prevalence of DA in girls when compared to boys.[30] However, some studies

showed no difference in DA between the genders.[31] Armfield et al reported that females have a greater prevalence of fear and more extreme fear than do males.[32]

2.3. Consequences of dental anxiety

It has been reported that DA is associated with increased levels of caries and behavioural management problems in paediatric patients.[24] In addition, patients with DA are found to have poorer oral function and oral aesthetics.[33] A Finnish study reported that 15% of the children did not seek care because of fear of dental treatment.[34] 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.[35]

Bray et al stated that avoiding preventive dental care appointments such as dental check-ups may lead to severe disease situations requiring more invasive dental procedures which will further lead to increased anxiety of the patient.[14] In addition, dentally anxious patients when compared to non-anxious patients have significantly more missing teeth, more carious lesions, and fewer and/or filled teeth, particularly in older adults.[36]

Dental anxiety leading to avoidance of dental treatment is common and is strongly associated with clinically significant deterioration of oral and dental health[11, 12] that in turn leads to a cycle of anxiety and increasing avoidance.[33] 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.[8, 33] 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.[28] Dental anxiety is also considered as a potential predictor of dental caries incidence.[29]

2.4. Causes of dental anxiety

Bare and Dundes[37] 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.

Pain or fear of pain is a primary source of anxiety, as well as a major obstacle to seeking dental care.[38] Dental injection was found to be the most powerful anxiety-provoking stimulus, followed by the dental drill.[39] In addition, highly anxious patients appear to be more sensitive to pain.[40, 41] 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.[39] The period of time spent waiting for the dental treatment in the waiting room has often been cited as a common reason for DA as it increases the time to ponder about the treatment and its outcomes.[42] Several primary research studies have shown that restorative dentistry procedures deliver the most potent triggers for DA, namely the sight, sound and vibrational sensation of rotary dental drills[42-44] coupled with syringe sight and sensation of a dental local anesthetic (LA) injection.[27, 42, 43] It is reported in the literature that children 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".[29] (p.479)

A qualitative study of participants who underwent a cognitive behavioural therapy (CBT) program for DF found that a sense of security was essential for patients to cope with dental care and this sense of security came from knowledge about the treatment and respectful dental care personnel.[45]

2.5. Measuring Dental Anxiety

There are several different measures of DA and these include self-reporting scales and physiological responses to anxiety. Self-reporting scales, which are quick and easy to employ are widely used to measure patients' or parents' (of a child) responses in

evaluating the level of anxiety; however, the validity for some of the scales is still up for some discussion.[46]

The Dental Anxiety Scale (DAS) includes four questions intended to measure the level of anxiety. The validity and reliability is acceptable. Wong and his colleague modified DAS into the Modified Dental Anxiety Scale (MDAS).[46] Porritt et al critically evaluated self-report measures to assess DA in children.[47] The DAS and MDAS consist 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’. The scales enable participants to indicate how relaxed or anxious they feel about four dental situations and explores the situational triggers of DA and physical reactions experienced by patients with DA.[47] The modified child dental anxiety scale (MCDAS) contains eight questions, four of which are based on the original DAS. In addition, anxiety-provoking dental situations are assessed by the MCDAS include dental injections, general anaesthesia, extraction and sedation.[47]

The facial image scale (FIS) can be used to ask children to indicate which of the faces they feel most like at that moment, thus, measuring state anxiety and the scale comprises one item with a response set of five faces (ranging from a very sad to a very smiley face).[47] The Venham picture scale (VPS) or the Venham picture test (VPT) is a pictorial ‘state’ measure of DA (suitable for children even as young as three) and incorporates eight pictures with each depicting two cartoon boys displaying contrasting emotions. The participant is required to indicate which of the boys, within the eight pictures, most accurately reflect their feelings at that time. However, the main disadvantage with this scale is ambiguity of some of the emotions displayed in the eight pictures (i.e. unclear what behaviour/feelings the pictures are displaying).[47] The Dental Fear Survey (DFS), a 27-item questionnaire is used to assess DA in adults, which was later modified to a 20-item measure of DA (modified version of the DFS) to assess DA in children in terms of their responses to various dental situations such as sight of the injection or the drill (handpiece).[47]

The children’s fear survey schedule dental subscale (CFSS-DS), a self-report measure developed from the Fear Survey Schedule for Children is a 80-item questionnaire designed to assess a variety of children’s fears and anxieties.[47] The CFSS-DS a dental-specific measure that requires children to rate their fear in response to 15 dental-related

situations/ treatments (e.g. ‘dentists’, ‘injections’ and ‘having somebody examine your mouth’) and it is shown to have high reliability and established cut-off points. The Dental fear schedule subscale short form (DFSS-SF) is a shorter version of the CFSS-DS measure that contains eight items and asks children to rate their fear and how they would feel in response to eight specific dental-related situations/treatments.[47] Smiley faces programme (SFP) and revised SFP are fully computerised measures incorporating items derived from the MDAS and include a seven-item FIS as an interactive response format. The original SFP measure requires children to indicate how they would feel in response to four dental scenarios (e.g. ‘Having to have dental treatment the following day’), and the revised SFP includes an additional dental scenario (‘about to have a tooth out’).[47] The Short version of the dental anxiety inventory (S-DAI) includes nine items and requires respondents to indicate their level of agreement with a number of dental-related statements (e.g. ‘When I know the dentist is going to extract a tooth I am already afraid in the waiting room’).[47] Most of these measurement scales can be used for both paediatric and adult patients, except for one or two that are specific to that particular age group.

Physiological responses to anxiety during dental appointments include increased blood pressure (BP), heart rate (HR), pulse rate, skin temperature and respiration rate. Heart rate has been a useful measure in assessing the level of anxiety in dental settings and in addition, physiological responses have been reported as indicators of anxiety and pain levels.[46]

2.6. Managing or minimising dental anxiety

Strategies for managing DA include but are not limited to minimal intervention dentistry approaches such as atraumatic restorative treatment (ART)[48, 49] and chemomechanical caries removal (CMCR) methods[50-52]; biofeedback;[53] hypnosis;[54] behavioural interventions or behaviour management techniques (BMTs);[55] music;[46] and relaxation;[11] and pharmacological strategies[56] involving the use of benzodiazepines, and antidepressants. Medications provide only short term cost effective solutions; but there are a 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.[14] In a study by Halvorsen et al[57] conducted in Norway on costs and social benefits of DF treatment, it

was found that only 24% of the patients were willing to pay the actual cost of the treatment before attending and 71% were willing to pay afterwards. The authors concluded that some level of subsidies will increase both allocative efficiency and social welfare.

Treatment of DA and choosing the right method of managing this disorder is not always easy.[20] 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.[58] 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.

Behaviour therapy and Cognitive therapy

Cognitive therapy, a type of psychotherapy is a form of therapy to manage anxiety by identifying and changing a patient's negative and false thoughts regarding dentistry. There are different types of cognitive therapies, which include group therapy, education, cognitive restructuring and the positive dental experience.[14] Behavioural therapies on the other hand are focussed on treating anxiety by changing or modifying a person's behaviour and these include systematic desensitisation, hypnosis, brief relaxation and musical distraction.[14] Cognitive-behavioural therapy (CBT) combines elements of both therapies in managing anxiety. Behavioural therapy (BT)/CBT is the most accepted form of psychological treatment for anxiety related to particular situations and objects.[15]

Special Clinics

Special Care Dentistry Clinics/Clinics of Oral Medicine have been set up in some countries where adult patients with severe DA may be referred to and these clinics provide tailored care, including both non-pharmacological and pharmacological treatments, for treating DA. In addition to help manage DA in patients, these clinics facilitate dental care in the short- and long-term perspective.[15]

Atraumatic restorative treatment/Chemo-mechanical caries removal

ART and CMCR are considered as alternative approaches to conventional methods of removing caries using local anaesthesia and rotary instruments. The ART pioneered in the mid 1980's in Tanzania is a minimal intervention approach that involves removal of caries using hand instruments followed by restoration of the excavated cavity using an adhesive restorative material, usually glass ionomer cement.[48] As dental drill is one of the causative factors of DA, ART eliminates the sight and sound of the rotary dental

drill; thereby potentially reducing DA.[48, 49] Essentially, ART does not involve the use of LA and rotary dental drills and thereby eliminates the two most important causes of DA, dental injection and dental drills. The ART approach has been found to be particularly useful in low resource settings and developing countries where running water supply and electricity are in scarce supply.[48, 49] However, it is reported that ART is increasingly being carried out in developed countries in particular population cohorts such as very young children being introduced to oral care, patients with extreme fear or anxiety about dental procedures, patients with special needs, home-bound elderly and nursing home resident patients, and patients from high-risk caries clinics.[59] It is also suggested that the environment (e.g. in a school dental clinic or a hospital set up) in which ART procedure is carried out may also influence DA, particularly in paediatric patients.[59] A systematic review conducted by Simon et al on the effectiveness of ART in reducing DA in paediatric patients concluded that ART was no more beneficial than conventional treatment in reducing DA among paediatric patients.[48]

Similar to the ART approach is the CMCR approach, which adheres to the concept of minimal intervention dentistry that is about conserving tooth structure with minimal use of rotary instruments and LA. The CMCR with its minimal intervention approach has a potential to reduce anxiety and fear in patients undergoing dental procedures. (Rafique et al 2003) The CMCR approach was introduced in 1972 in the form of Caridex solution, which evolved currently into Carisolv gel.[60] The CMCR procedure involves the use of a gel (e.g. usually Carisolv, Papain/Papacarie), which softens the affected dentin, which is then removed by hand instruments instead of rotary instruments.[51, 52, 60]

Aromatherapy and acupuncture

Aromatherapy and acupuncture are complementary and alternative interventions. Aromatherapy involves the use of aroma compounds such as essential oils/fragrances from flower/herbal extracts in order to alter a person's mind, mood or cognitive function.[61] There is a lack of clear details on how exactly aromatherapy controls anxiety and/or alleviates pain; however, it is thought that the aromas or fragrances might stimulate the limbic system, which in turn may excite neuronal cells to release neurotransmitters.[61, 62] It is also thought that the aromas might affect human emotions and behaviour through emotional learning, conscious perceptions, beliefs and expectations.[61, 62] In essence, it is postulated that aromas produce positive pharmacological and physiological effect by the sense of smell, thereby facilitating or

alleviating anxiety and/or pain.[63] The most commonly used essential oils or fragrances in a dental setting include orange, lavender, and apple green oils/scents. It is further reported that orange (fruit of the Citrus aurantium species)[61] oil increases the activity of parasympathetic nervous system by 12 % and decreases the activity of sympathetic nervous system by 6%[63, 64]. Lavender (Lavandula angustifolia) fragrance is associated with parasympathetic stimulation of the autonomous nervous system that in turn leads to decreased anxiety, improved mood and increased sedation.[65]

Acupuncture, another form of non-pharmacological alternative intervention to manage DA has been reportedly examined in few studies as the literature on this intervention is generally sparse, particularly in the dental settings. Acupuncture at the outer ear, also known as auricular acupuncture has been shown to have an anxiety-reducing effect in medical settings.[66] Acupuncture at the outer ear is preferred as it is minimally invasive and the outer ear is easily accessible to the dentist.[66] Acupuncture generally involves the use of anxiety-reducing acupoints in the human body to alleviate anxiety and also to facilitate hypnotic induction to control anxiety.[66]

Behavioural interventions

Behavioural interventions to reduce DA and dental fear are often based on concepts related to learning, social learning, and cognitive theory.[15] Psychological interventions are usually broadly categorised into behavioural therapy or CBT interventions and are the commonly accepted forms of psychological treatment for anxiety, particularly in dental settings. The terminology around these interventions is unclear and some of the terms are used interchangeably, particularly in the dental literature. Behavioural interventions (such as graded exposure, systematic desensitisation, audiovisual (AV), hypnosis, and relaxation) and cognitive interventions (such as cognitive restructuring, CBT) are sometimes combined in clinical practice and they are often categorised as either behavioural interventions or psychological interventions.

In general, there is a need, within the health-care system (both in medical care and in dental care) to evaluate different types of treatment for diseases and conditions. The obvious reason is that the best treatments should be used routinely with regard to effectiveness, cost, and patient-related outcomes. Moreover, it is equally important to reduce, or even terminate, the use of ineffective treatment methods.

Hypnosis

Hypnosis is defined as an interaction in which the hypnotist uses suggestive techniques or scenarios to shift a person's focus towards inner experiences and to influence the subject's perceptions, feelings, thinking and behaviour.[67] Hypnosis in the past, mainly through case reports has been shown to be beneficial in managing DA, specific DP, pain control in conservative treatment and extractions, for improved tolerance for orthodontic appliances, as an adjunct to inhalation sedation, or to aid in the induction of GA.[54, 68, 69]

Music

Music, including music listening and music therapy is a form of relaxation, which can have a positive influence on the patient by making concentration easier and easing anxiety.[46] Music does not only help in relaxing during treatment or surgery, but is also a popular daily stimulus for many people.[70] There are different types of music (e.g., folk, contemporary, classical, lullaby). Music theorists 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.[46]

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).[46] According to the Australian Music Therapy Association, active music therapy is the planned and creative use of music by a music therapist to attain and maintain health and wellbeing and people of any age or ability may benefit from a music therapy program regardless of musical skill or background.[46] Passive music listening is the passive listening to pre-recorded music offered by healthcare professionals without the involvement of music therapist.[71]

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.[72, 73] 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.[73]

Studies have reported that music intervention decreases surgical stress, induces relaxation, decrease blood pressure (BP), heart rate (HR) and respiratory rate (RR) during an operation in local anaesthesia in medical populations.[74] The systematic

review by Moola et al[46] concludes that for a musical intervention to be effective in reducing DA and dental fear, it is important to consider the type of music, volume of the music, type of headphones and patient's preferred choice of music.

Music helps 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.[72]

Dental Environment and Waiting Rooms

Despite many advances in paediatric dentistry, the greatest challenge for any paediatric dentist is to remove the anxiety related to a dental visit and have a child patient to accept dental treatment readily. Minor changes made in the waiting room design can have a major effect on the way any child perceives the upcoming dental experience.[29] The child's perception of the dental environment is a significant factor causing DA. If the color of the dental environment can have a positive impact on the child's behaviour, it is possible that those colours may add to the comfort of a child, thus reducing DA (Umamaheshwari et al (2013)).[75]

2.7. Systematic Reviews of non-pharmacological interventions

Several systematic reviews of effectiveness have been published previously on some of the interventions to manage DA, which included ART,[48] music,[46] hypnosis,[67] and behavioural/psychological interventions[15, 76]. Most of these systematic reviews that were published focused only on the effectiveness of a particular intervention in a particular age group, mostly in paediatric patients and/or included specific or narrow inclusion criteria. However, this linked series of systematic reviews provides a comprehensive overview on the best available evidence in relation to non-pharmacological management of DA in paediatric and adult patients undergoing various dental treatments/procedures in various dental settings. The advantages of alleviating DA in paediatric patients and adults using the non-pharmacological approaches could potentially include fewer dental avoidances, avoiding side-effects/adverse effects of pharmacological interventions, improved oral health care and attitudes as well as

improved oral health practice outcomes, while simultaneously conserving tooth structure.

2.8. The program of inquiry

The contribution to knowledge this thesis brings is multi-fold. Firstly, the conduct of a linked series of systematic reviews on a range of non-pharmacological interventions to manage DA has not previously existed in this area. The series of reviews followed rigorous systematic methods to identify, locate, collect and analyse data in order to generate new knowledge based on the available evidence.

Secondly, the thesis provides a comparative description of various interventions in terms of their effectiveness, meaningfulness, appropriateness and feasibility for various dental procedures and in various dental settings. Many traditional systematic reviews in the dental field focussed predominantly on the systematic review of quantitative evidence and more specifically on RCTs to ascertain the effectiveness of a particular intervention. Comprehensive systematic reviews, also known as mixed method reviews and which include multiple types of evidence, are increasingly becoming popular as they provide a complete picture of the best available evidence. The systematic review component of this thesis was undertaken to provide a comprehensive picture of the best available evidence on non-pharmacological management approaches in reducing DA in both paediatric and adult patients in the general population and excludes persons with special needs.

The thesis is based on the Joanna Briggs Institute's broad approach[(2)] to including all types of evidence and utilises its approaches and methodologies to address questions of effectiveness, meaningfulness, appropriateness and feasibility.

Ethics approval was not required for this thesis as only secondary data were utilised and did not include any primary research involving animals or humans.

3. Design and Conduct of the program of Study

3.1. Review Objectives

The overall objective of this series of systematic reviews was to identify and synthesise the best available effective, meaningful and/or appropriate evidence on non-pharmacological interventions in the management of DA and dental fear in paediatric and adult patients.

The objective for the quantitative component of the review was to identify and synthesise the best available evidence on the effectiveness of non-pharmacological interventions for managing and reducing DA in paediatric and adult patients.

The objective of the qualitative component was to identify and synthesise the best available evidence on the experiences of paediatric and adult patients' with dental anxiety receiving non-pharmacological interventions. Qualitative reviews draw together evidence of meaningfulness, which can be defined as "'the extent to which an intervention or activity is experienced by the patient, that is related to the personal experience, opinions, values, thoughts, beliefs and interpretations of patients or clients."49

The objective of the economic component was to identify and synthesise the best available evidence on the feasibility of non-pharmacological interventions in terms of their cost-effectiveness and cost-benefit aspects. Including evidence from economic evaluation studies, where identified and possible to include provides a complete picture of the evidence on intervention/s that aligns with the JBI approach to conceptualising evidence in terms of FAME.

3.2. Review questions

What are effective non-pharmacological interventions to manage dental anxiety in paediatric and adult patients prior to, during and after dental procedures and dental check-ups?

What are effective non-pharmacological interventions to manage dental anxiety in paediatric and adult patients in the waiting room of the dental office?

What are paediatric and adult patients' experiences receiving non-pharmacological interventions to manage dental anxiety?

What is the perception and satisfaction of both paediatric and adult patients regarding the use and provision of non-pharmacological interventions to reduce DA?

What is the best available evidence on the cost effectiveness, cost benefit, cost minimization, and/or cost utility of non-pharmacological interventions for managing DA in paediatric and adult patients?

3.3. Review Methods

3.3.1. Inclusion criteria

3.3.1.1. Types of participants

The quantitative, qualitative, textual and economic components of this review considered studies that included paediatric (one to 18 years old) and adult patients (18 years and above) undergoing dental procedures in any dental setting. Dental clinicians and dental therapists in dental clinics and hospitals, both public and private were also included. The participants included healthy paediatric and adult patients so as to target a specific population who would most benefit from dental anxiety treatment. Persons with special needs were excluded from this program of work.

3.3.1.2. Types of intervention(s)/phenomena of interest

The quantitative component of the reviews considered studies that evaluated various non-pharmacological interventions. The interventions were examined in comparison to the standard or conventional treatment approach, which included use of LA and rotary instruments for caries removal and tooth restoration, or another intervention.

The qualitative component of this review considered studies that investigated and explored the experiences of paediatric and adult patients with DA receiving non-

pharmacological interventions as well as the experiences of dental personnel providing these interventions.

The textual component of this review considered publications that described the expert opinion/consensus regarding non-pharmacological interventions.

The economic component of this review considered publications that included cost-effectiveness non-pharmacological interventions.

3.3.1.3. Context

The reviews considered studies that focused on the experiences of paediatric and adult patients' dental anxiety levels in relation to non-pharmacological interventions in any setting where dental clinicians and/or dental therapists practised or were able to perform these procedures.

3.3.1.4. Types of outcomes

The reviews considered studies that included the following outcome measures: dental anxiety was the primary outcome of interest. Dental anxiety was measured by various validated and reliable scales and/or tools. Psychometric and behaviour rating tools/scales included Corah's dental anxiety scale (CDAS), dental anxiety inventory-short version, dental subscale of Children's Fear Survey Schedule (CFSS-DS), facial image scale (FIS), Frankl's behavioural scale, hierarchical anxiety questionnaire (HAQ), modified dental anxiety scale (MDAS), Smiley faces program (SFP), visual analogue scale (VAS) and Venham picture scale/test (VPT). Physiological measurements such as heart rate, pulse rate, blood pressure and salivary secretion, which are considered as surrogate markers/measures of dental anxiety levels and used to measure DA were also considered.

Associated outcomes such as pain, patient experiences, patient satisfaction, patient acceptance and adaptation, patient preference, quality adjusted life years (QALYs), dental attendance, improved oral health, clinician attitude and satisfaction were only considered when DA was examined and measured as this was the main objective of the systematic reviews.

In addition, the series of reviews focused on any outcome related to the cost of implementing non-pharmacological interventions in a dental setting. The reviews aimed to examine whether there were any cost benefits and savings to the dental providers which offered one or both interventions to reduce DA in paediatric and adult patients.

3.3.1.5. Types of studies

The quantitative component of the review considered both experimental and observational study designs including RCTs, non-RCTs, quasi-experimental, before and after studies, prospective and retrospective cohort studies, case control studies and analytical cross sectional studies for inclusion. Descriptive study designs including case series, individual case reports and descriptive cross sectional studies were considered for inclusion in the absence of experimental and observational study designs.

The qualitative component of the review considered designs such as phenomenology, grounded theory, ethnography, action research and feminist research.

The textual component of the review considered expert opinion/consensus, guidelines and other relevant text but excluded brief summary articles, editorials, opinion pieces and articles where the author could not be identified as an expert in the field.

The economic component of the review considered cost effectiveness, cost benefit, cost minimization, cost utility studies. Quantitative studies that measured clinical effectiveness and incorporated economic data were also considered.

Systematic reviews were not considered for inclusion; however, primary studies included in the identified systematic reviews were retrieved if not identified in the search.

3.3.2. Search strategy

The search strategy aimed to find both published and unpublished studies. A three-step search strategy was utilized. An initial limited search of MEDLINE (PubMed) and CINAHL was undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe the article. A second search using all identified keywords and index terms was undertaken across all included databases.

Thirdly, the reference lists of all identified reports and articles at the full-article stage were searched for additional studies; however, no articles reviewed at this time were deemed necessary to be include in this project work. Studies published in English language and other languages where a translation was available (e.g. Chinese) were considered for inclusion in this review. There was no time limit on the search period and all the databases were searched from their inception to July 2015 and an updated search was conducted from August 2015 to December 2016.

The databases searched include:

- Cochrane Central Register of Controlled Trials
- CINAHL
- Embase
- ERIC
- Medline
- Web of Science
- Scopus
- PsycINFO
- ISI Web of Knowledge
- NHS Economic Evaluation Database (NHS EED)
- Health Economic Evaluation Database (HEED)
- Cost-Effectiveness Analysis (CEA) Registry
- Paediatric Economic Database Evaluation (PEDE)

The search for unpublished studies included:

- Google Scholar
- Index to Theses
- Directory of Open Access journals
- Networked Digital Library of Theses
- Mednar
- Relevant Organization Websites such as the American Dental Association (http://www.ada.org/en/) and the Australian Dental Association (http://www.ada.org.au/).
- Relevant Networks such as the evident Foundation (http://www.evident.net.au/) and the Dental Practice-Based Research Network (http://www.nidcr.nih.gov/).
- Government Websites such as the NHS Choices (http://www.nhs.uk/pages/home.aspx).

Initial keywords used:

Dental anxiety, dental fear, dental phobia, paediatric, adults, patients, pharmacological, non-pharmacological, behavioural therapy, sedation, psychotherapy. The full search strategy for Medline and CINAHL is provided in Appendix I.

3.3.3. Critical appraisal

Studies selected for retrieval were assessed by two independent reviewers for methodological validity prior to inclusion in the review using the JBI standardised critical appraisal instruments[5] for various study designs, including quantitative studies, economic evaluation studies, qualitative studies and text and opinion papers (Appendix II). Any disagreements that arose between the reviewers were resolved through discussion, or with third reviewer/s.

3.3.4. Data collection

Quantitative including economic evaluation data and qualitative and text and opinion findings were extracted from papers included in the review using the JBI standardised data extraction tools (Appendix III). The quantitative data extracted included specific details about the interventions, population (including sample size), study methods, treatment phase (i.e. before, during or after the procedure), type of dental setting, outcomes including costs and costs benefit data and outcome measures of significance to the review questions. Qualitative and text and opinion data extraction included details such as population, context, study method, geographical and cultural setting, findings and conclusions.

3.3.5. Data synthesis

Quantitative data were, where possible, pooled in statistical meta-analysis using RevMan 5.3.5. All results were subject to double data entry. Meta-analyses were conducted where included studies were appropriately similar. Effect sizes expressed as a relative risk for cohort studies, odds ratios for case control studies (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals were calculated for analysis. Clinically, the sample included in the studies had similar characteristics without any prior exposure to the intervention of interest with all the patients undergoing same procedure, i.e. caries removal or tooth restoration or scaling/cleaning of teeth or tooth extraction or orthodontic procedures.

A narrative synthesis of data is provided where study interventions and methods precluded meta-analyses and the narrative synthesis is aided through some data presented in tabular format, where applicable and relevant. A random effects model using inverse variance method was used to calculate effect sizes for continuous data. Dental anxiety levels and physiological measures such as pulse rate were expressed as mean and standard deviations (mean ± SD) and where possible studies that provided this data (weighted mean differences) along with their 95% confidence intervals were included in meta-analyses. Weighted mean differences were used for continuous outcomes.

Random-effects meta-analyses were used if there were two or more than two homogenous studies. For continuous data, pooled outcomes will be expressed as mean differences with their associated 95% confidence intervals. For binary data, these will predominately be pooled risk ratios and associated 95% confidence intervals. Heterogeneity was assessed statistically using the standard Chi-square. Where statistical pooling was not possible, the findings were presented in narrative form including tables and figures to aid in data presentation where appropriate.

It was not possible to pool qualitative research findings were, as very few studies were identified and included in the reviews. Textual papers were, where possible, pooled using JBI-NOTARI. This involved the aggregation or synthesis of conclusions to generate a set of statements that represent that aggregation, through assembling and categorising these conclusions on the basis of similarity in meaning. The first step was to generate a set of statements that represented the aggregated data through assembling the conclusions rated according to their quality. Then, findings were categorised based on similarity of meaning. The final step was through meta-aggregation of the categories to produce a single comprehensive set of synthesised findings that was used as a basis for evidence-based practice.

4. Results

4.1. Study selection

A total of 15,020 studies were identified in the search. Further to the search, an updated search was performed for recency of the systematic review from May 2015 to December 2016. A total of 1,927 studies were identified in the updated search. Following removal of duplicates, the titles and abstracts of 7,550 studies were screened. Following screening, full texts of 887 studies relevant to all nonpharmacological interventions were retrieved and examined. On full text examination, 500 studies were excluded for various reasons based on the inclusion criteria. Three hundred and eighty seven studies were assessed for methodological quality and based on poor quality of studies, 99 were excluded (Appendix IV). The final report of this series of systematic reviews included 288 studies, of which 14 studies were purely qualitative and/or text and opinion in nature and were summarised and synthesised accordingly. The rest 274 studies were quantitative study designs including RCTs, quasi-experimental studies, observational and descriptive studies and case reports. Meta-analyses were conducted where appropriate. The rest were summarised in a narrative form and/or presented in a tabular format. Please refer to the study selection flow chart (Figure 3).

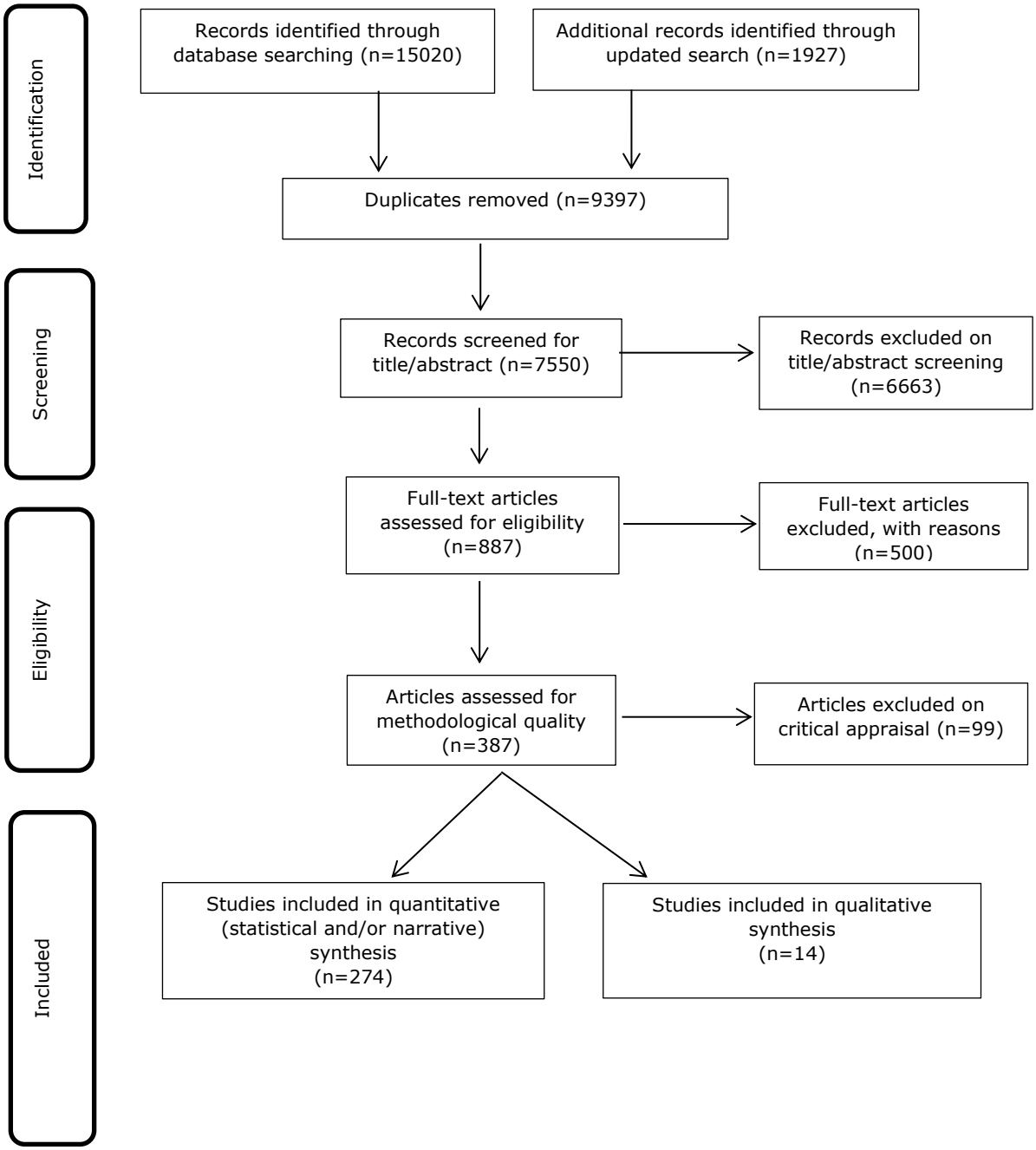


Figure 3: PRISMA flow diagram of search and study selection process[77]

4.2. Overall characteristics of the studies and methodological quality

Overall, 288 studies were included in this comprehensive linked series of systematic reviews. The majority of the studies were conducted in the USA, followed by countries in Europe and Asia. The reviews included a combination of study designs, with the majority being RCTs, quasi-experimental studies, descriptive and analytical surveys and case reports. There were few qualitative studies and expert opinion articles and two economic evaluation studies. Studies that examined behaviorally oriented interventions were specifically directed towards paediatric patients. Interventions such as CBT, hypnosis, aromatherapy, biofeedback particularly included adult patients as the study populations.

The 288 studies that were selected for inclusion in the review were critically appraised for methodological quality using the appropriate JBI checklists for RCTs, quasi-experimental, cohort, case control, cross sectional, case series, case reports, qualitative and expert opinion studies. The crucial appraisal of articles focused on the reliability and validity of the study methods and findings. Experimental studies were assessed as meeting the criteria for methodological quality if they demonstrated that groups were comparable at entry, received the same treatment other than the intervention and the outcomes were measured in the same way for all study participants. The process was undertaken by two reviewers independently. A third reviewer was consulted where in the two reviewers could not reach an agreement. Those studies that did not meet the methodological quality criteria required for inclusion were excluded (Appendix IV). Emails were sent to authors requesting missing/ incomplete data or to clarify any ambiguity.

The methodological quality of the included studies was variable with the majority being of moderate methodological quality. Almost all the included RCTs did not provide details on randomisation; therefore, it was not clear whether it was a true randomisation process in assigning study participants to treatment groups. The studies did not provide sufficient details on participant blinding and allocation concealment. In almost all the included studies, there were no significant differences in baseline characteristics between the treatment groups or treatment and control groups; all the study participants were treated in the same way; the outcomes were measured in a valid and reliable way using

standardised outcome measurement scales; and appropriate statistical analyses were used to measure the outcomes. Majority of the studies had small sample sizes, mostly in a range of 20 to 50.

4.4. Findings of the review – Based on various interventions examined

Studies were grouped by the interventions examined and where relevant according to the population of interest; i.e. children and adults. All of the studies included in the review measured physical and emotional responses of patients and in some cases parents of patients to pre- and post-treatment anxiety. Physiological responses to anxiety, such as heart rate (HR), blood pressure (BP), respiration rate (RR) and were also examined in several studies.

4.4.1. Aromatherapy and Acupuncture

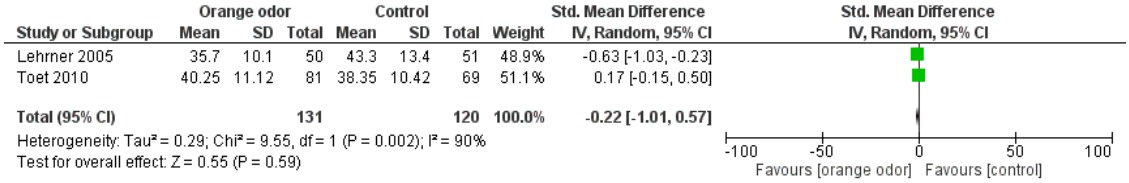
Overall 11 studies were identified and included in the review that examined aromatherapy or acupuncture. Nine studies examined aromatherapy and two studies examined acupuncture to relieve and/or manage DA.[61-65, 78-81] Eight out of nine studies that examined aromatherapy used either orange odour/fragrance or lavender odour/fragrance in dental clinical settings in comparison to no odour/fragrance. One out of eight studies examined aromatherapy using both orange and lavender odours in comparison to no odour.[80] In addition, one of the studies also examined the effects of scents of apples.[62] One study examined the sedative effects of Passion flower. Five studies were trials and four were quasi experimental studies.[78] All nine studies except one[63] included adult patients as the sample population. Two studies examined the effects of acupuncture, specifically auricular acupuncture in the management of DA.[66, 82]

Aromatherapy

Orange odour vs control (no odour/fragrance)

In total, five studies included in the review examined the effect of orange odour/fragrance in reducing DA in paediatric and adult patients. In the meta-analysis (Figure 4) that included two quasi-experimental studies[62, 80] comparing orange odour/fragrance with a control group in adult patients, it was shown that orange odour was effective in reducing DA; however, this was not significant but showed a trend towards orange odour. The two studies were conducted in the waiting rooms of dental clinics. In the study by Lehrner (2005), it was reported a significant group difference between the control group and the orange group ($p = 0.049$).[80] The study included 200 patients between the ages of 18 and 77 years. The study by Toet et al included 219 patients between the ages of 18 and 81 years who were waiting for dental treatment in three large dental clinics in the Rotterdam area in the Netherlands.[62] The participants were either exposed to the ambient odour of orange (N=81) or apple (N=69), or they received no stimulation. Statistical analysis showed no significant difference between the responses of patients in each of the three experimental groups.

Figure 4. Orange odour vs control (no odour/fragrance)



Hasheminia (2014), measured vital signs during and just after surgery, which showed that the mean BP, PR, and RR were significantly reduced in the orange fragrance group. A total of 56 patients participated in the present study (Table 1).[61]

Table 1. Physiological measurements – Orange odour vs no fragrance

Physiological Variable	Orange odour Group	No-Fragrance Group	P Value
BP (cm/Hg)			
Stage 1	9.81 ± 1	9.63 ±0.76	0.46
Stage 2	9.63 ± 1	9.82 ± 0.86	.46
Stage 3	9.47±0.88	10.26 ±1.2	.007
Stage 4	8.75 ± 0.87	10.37 ± 1.7	<.001
Stage 5	9.12 ±0.98	10.44 ±1	<.001
PR (bpm)			
Stage 1	100.42 ± 9.5	100.17 ±12.7	.93
Stage 2	98.82 ±9.5	102.28 ±13.5	.27
Stage 3	96.9 ± 9	106.25 ± 14.1	.005
Stage 4	98.57 ± 12.4	106.89±13.2	.02
Stage 5	95.14 ± 10.9	104.71 ±11.7	.003
RR (breaths/min)			
Stage 1	25.57 ± 1.87	27.14 ±2.2	.44
Stage 2	27.92 ±_ 2.27	27.78 ±2.8	.83
Stage 3	27 ±1.9	29.64 ±2.9	<.001
Stage 4	26.14 ±2.3	30 ±_ 2.7	<.001
Stage 5	27±1.8	29.85 ± 2.4	<.001

Jafarzadeh et al conducted a crossover intervention study including 30 children aged between 6-9 years and every child underwent two dental treatment appointments including dental prophylaxis and fissure-sealant therapy under orange aroma in one session and without any aroma in the other session.[63] Child anxiety level was measured using salivary cortisol and pulse rate before and after treatment in each visit. The difference in means of salivary cortisol and pulse rate between treatment under orange odour and treatment without aroma was 1.047 ± 2.198 nmol/l and 6.73 ± 12.3 (in minutes), which was statistically significant (P = 0.014, P = 0.005, respectively).

In another study by Lehrner et al that included 72 patients between the ages of 22 and 57 years waiting for dental treatment, it was reported that exposure to ambient odour of orange had a relaxant effect.[64] Specifically, compared to the controls, women who were

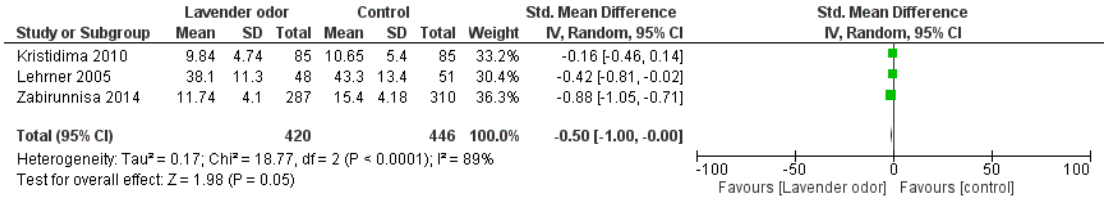
exposed to orange odour had a lower level of state anxiety, a more positive mood, and a higher level of calmness (Female (1, 71) = 4.6, p < 0.04).

Lavender odour vs control

Three studies examined the effect of lavender odour/fragrance/scent in reducing DA in adult patients and a meta-analysis was conducted including the three studies. Overall, the meta-analysis showed that there was a significant reduction in DA in patients exposed lavender odour/scent when compared to those in the control group with no odour or fragrance.

In a patient-masked cluster RCT conducted in a private dental practice in Athens, Greece by Kristidima et al that included 340 adults aged over 18 years, anxiety was assessed while waiting for a scheduled dental appointment, either under the odour of lavender or with no odour.[79] Analysis showed that although both groups showed similar, moderate levels of generalised DA (MDAS F = 2.17, P > 0.05); however, the lavender group reported significantly lower current anxiety (STAI: F = 74.69, P < 0.001) than the control group. In the study by Lehrner et al, the comparison between lavender group and control group revealed a statistical group difference (p =0.039) in that the patients who were exposed to lavender odour had a lower level of state anxiety, a more positive mood, and a higher level of calmness compared to the patients in the control group.[80] Zabirunnisa et al conducted a study that included two comparison groups (lavender and control group), each comprising five dental clinics.[65] The analysis showed a significant (p=0.001) reduction in anxiety scores of lavender group compared with the control group (Figure 5).

Figure 5. Mean and SD scores comparing lavender odour with control (no odour)



Passion flower

Kaviani et al examined the efficacy of Passion flower as an oral premedication in reducing anxiety during the dental procedures. Sixty-three patients, with moderate, high and severe anxiety (VAS score) in need of periodontal treatment were randomly divided

into 3 groups of 21.[78] The first group was given the Passion flower drop and the second group were given the drop of placebo and the third group; neither drug nor placebo were given (negative control group). Mean anxiety level prior to the premedication administration was 12.09±2.42 for the Passion flower group, 12.00±2.66 for the placebo group and 11.66±2.39 for the negative control group. After premedication, these values were: 8.47±2.58 for the Passion flower group, 10.52±2.11 for the placebo group and 11.23±2.34 for the negative control group. Overall, these results demonstrated a significant difference ($p<0.0001$) in the anxiety levels before and after the Passion flower administration in the Passion flower group and between the Passion flower group and the other two groups.[78]

Acupuncture

Two studies included in the review examined the effectiveness of acupuncture in reducing DA. Karst et al in their trial compared the efficacy of auricular acupuncture with intranasal midazolam, placebo acupuncture, and no treatment for reducing DA.[82] Patients having dental extractions (n = 67) were randomised to (i) auricular acupuncture, (ii) placebo acupuncture, and (iii) intranasal midazolam and compared with a no treatment group. Anxiety was assessed before the interventions, at 30 min, and after the dental extraction. With the no treatment group as control, the auricular acupuncture group, and the midazolam group were significantly less anxious at 30 min as compared with patients in the placebo acupuncture group (STAI X1, $p=0.012$ and <0.001, respectively). In addition, patient compliance assessed by the dentist was significantly improved if auricular acupuncture or had been performed ($p=0.032$). Auricular acupuncture was effective for the treatment of DA.[82]

Table 2 Behavioural Variables at Baseline, Follow-Up 1, and at Follow-Up 2

Variable	Baseline	Follow-up 1	Follow-up 2
STAI X1			
Auricular	50.47±8.83	43.53±9.99	41.84±12.72
Placebo	49.32±13.49	45.21±10.82	39.16±9.87
Midazolam	56.53±9.61	42.16±9.12	38.68±9.19
No treatment	53.00±9.61	56.50±9.10	47.20±12.78
VAS (0-10)			
Auricular	4.25±3.02	3.03±2.16	1.73±1.71
Placebo	4.36±3.00	3.21±2.74	1.20±1.65
Midazolam	5.35±2.41	3.32±2.41	1.72±1.68
No treatment	5.57±2.53	5.71±2.83	1.61±1.56

Michalek-Sauberer conducted a randomised study with 182 patients that compared state anxiety before dental treatment following auricular acupuncture at the relaxation-, tranquillizer- and master cerebral points (auricular acupuncture group) versus acupuncture at sham points (finger-, shoulder and tonsil points; sham group) and a non-intervention control group.[66] Auricular acupuncture reduced state anxiety (assessed using the STAI (German version)) score more effectively from 54.7±10.8 to 46.9±10.4 (mean ± SD) than sham acupuncture from 51.9±10.2 to 48.4±10.0. In contrast, state anxiety in the control group increased from 51.0±11.7 to 54.0±11.6 (mean increase +3.0; CI +4.7 to +1.2). The decrease in state anxiety in both intervention groups was statistically significant ($p<0.001$) when compared to the non-intervention control group (Table 3).

Table 3 Anxiety: Baseline VAS score and state- and trait anxiety before acupuncture intervention as well as state anxiety after acupuncture

	Auricular acupuncture	**Sham group**	**Control**	**p auricular acupuncture vs sham**	**p auricular acupuncture vs. control**
VAS anxiety	5.9 (4.2–7.7)	5.1 (4.0–6.7)	5.3 (3.8–6.5)	0.512	0.754
STAI-trait	40.7±11.5	38.9±9.2	39.6±12.1	0.547	0.898
STAI-state before intervention	54.7±10.8	51.9±10.2	51.0±11.7	0.272	0.853
STAI-state before dental treatment	46.9±10.4	48.4±10.0	54.0±11.6	0.008	<0.001

Table 4 Assessment of methodological quality (Aromatherapy and Acupuncture)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Hasheminia et al 2014	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Jafarzadeh et al 2013	Crossover Pseudo RCT	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Karst et al 2007	RCT	U	Y	Y	N	Y	Y	Y	Y	Y	Y	I	8
Kaviani et al 2013	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Kristidima et al 2010	Cluster RCT	Y	Y	Y	N/A	N	Y	Y	Y	Y	Y	I	8
Lehrner et al 2000	RCT	U	N	N	U	N	Y	Y	Y	Y	Y	I	5
Lehrner et al 2005	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Michalek-Sauberer et al 2012	RCT	Y	Y	Y	N	N	Y	Y	Y	Y	Y	I	8
Porter et al 2005	Quasi-experimental	N	N	N	N	N	U	U	Y	U	U	E	0
Rosted et al 2010	Cross sectional	N	Y	N/A	N	N	U	N	Y	Y		E	3
Toet et al 2010	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Venkataramana et al 2016	Cluster RCT	Y	N	N	N/A	N	Y	Y	Y	Y	Y	I	6
Zabirunnisa et al 2014	Cluster RCT	Y	N	N	N/A	N	Y	Y	Y	Y	Y	I	6

4.4.2. Atraumatic restorative treatment/Chemo-mechanical caries removal

Characteristics of included studies

Sixteen studies including nine randomised controlled trials (RCTs), three split mouth RCTs (mainly in CMCR approach), three crossover RCTs (all in CMCR approach), and one stratified block RCT were included in this systematic review.[49-52, 59, 60, 83-92] Split mouth RCT is unique to oral health research, where the unit of randomization is the site or quadrant in the mouth and the patient receives two or more treatments in each quadrant of the mouth; whereas in crossover RCTs, the participants receive treatment/s in sequence. In split mouth RCTs, participants act as their own control thereby eliminating between subject variability. However, there is a limitation with these types of trials in terms of the carry-over effects. All the studies included in this review compared ART using hand instruments with CRT using rotary instruments. All included paediatric patients (mainly between 6-8 years old) as the sample population and were conducted in developing countries except one study.[49] The study by Mickenautsch et al was the only study that included both paediatric and adult patients. DA was the primary outcome.[87] The studies were carried out in either dental clinic/hospital or school settings.

Atraumatic Restorative Treatment (ART)

Ten studies including, seven RCTs one stratified block RCT, one split mouth RCT and one quasi experimental study were included. The RCTs were conducted in Brazil, India, Indonesia, Pakistan, South Africa, and Suriname; the stratified block RCT was conducted in Australia and the split mouth RCT was conducted in India. Majority of the studies included children as their sample population, with the most common age range between 6-7 years. The sample size in the included studies ranged from 30 to 403. Studies were either conducted in a dental clinic or on school premises.

Chemo-Mechanical Caries Removal (CMCR)

Six studies were included in the final report. There was one RCT, three crossover RCTs and two split mouth RCTs. Only one out of the six studies included adult patients and the rest five included paediatric patients. Three studies were conducted in India one study

in Denmark/Portugal, one study in the United States and another one in the United Kingdom. The sample size ranged from 20-60 in the studies that included children and in the one study that included patients older than 13 years, the sample size was 22. Almost all the studies were conducted in dental clinics affiliated with a dental school or university or research centre.

ART & CMCR

The study by Topaloglu-Ak et al also compared both ART with CMCR. This study was a compilation of three different trials that compared ART vs conventional restorative treatment (CRT) in a dental clinic; ART vs CMCR in a dental clinic; and ART vs CRT on school premises.[89] This study was conducted in a Dental school in Turkey.

4.4.2.1. Atraumatic Restorative Treatment

Three RCTs that compared ART with conventional restorative treatment (CRT) in paediatric patients were included in a meta-analysis (Figure 6),[83, 87, 89] which showed that there was no statistically significant difference between ART and CRT in reducing DA; however, the studies showed a trend towards ART with the study by Mickenautsch et al[87] showing a significant difference between ART and CRT. The summary effect size was −2.18 (95% CI: −4.55, 0.19). There was significant statistical heterogeneity, possibly due to different outcome measurement scales. The studies by De Menezes Abreu et al[83] and Topaloglu-Ak et al[89] used scales with faces/images as an indicator of children's DA, whereas Mickenautsch et al[87] used a shortened form of the CFSS-DF, a self-reported questionnaire consisting of 15 items. In addition, the participants in the study by Mickenautsch et al[87] included dentists and dental operators treating paediatric patients as participants who rated children's DA levels, in contrast to the two other studies[83, 89] which directly elicited responses and assessed DA in paediatric patients. Also, in terms of clinical heterogeneity, these studies were conducted in different countries and in different settings; there were differences in the size of the cavities treated, the types of participants and operator/patient responses.

However, in a sensitivity analysis (Figure 7) that excluded the study by Mickenautsch et al[87] it was clearly shown that there was no significant difference between ART and CRT

and the studies[83, 89] were quite homogenous with no significant statistical heterogeneity. However, Mickenautsch et al[87] had correctly assessed dental fear, i.e. immediately after the treatment as required by the assessment scale; whereas the study by Topaloglu-Ak[89] used VPT after the treatment procedure when in fact it should have been used before the start of the treatment, a requirement for the use of the scale.

Figure 6. Mean difference in dental anxiety in paediatric patients treated with ART compared with CRT

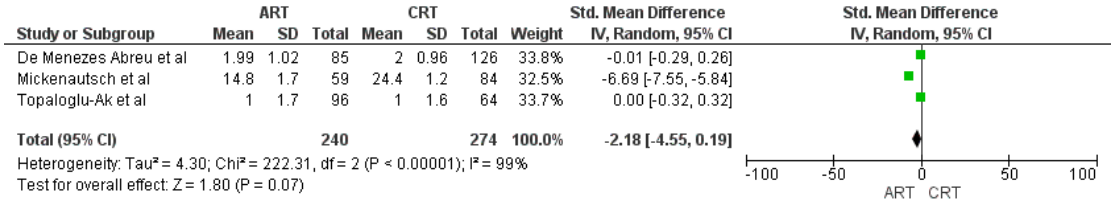
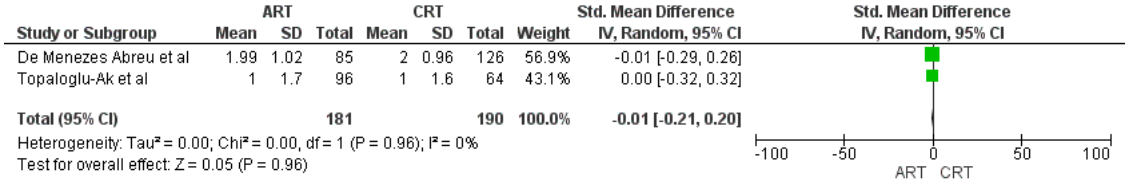


Figure 7. Sensitivity analysis – mean difference in dental anxiety in paediatric patients treated with ART compared with CRT



Three studies assessed anxiety levels using VPT and heart rate measurements at different points in time during caries removal. Goud et al[85] and Schriks et al[88] compared ART with minimal cavity preparation (MCP) at different points in time during caries removal procedure; whereas the study by Roshan et al[59] assessed the effectiveness of ART between two treatment groups, i.e. ART performed in a school environment and in a pedodontic dental clinic setup.

As seen in Table 5, in the studies by Goud et al[85] and Schriks et al[88], there were no significant differences reported with Venham scores between the treatment groups (P = 0.153 and 0.256, respectively) as the paediatric patients entered into the operating room. However, in both the studies, during three different treatment phases (start, deep excavation & restoration), the Venham scores of paediatric patients in the ART group were found to be significantly lower than those in the MCP group (P<0.05). Overall, the results (Venham scores) indicated that children treated with ART were significantly more comfortable and less anxious when compared to paediatric patients treated with MCP (P<0.05) in both the studies. Marginally nonsignificant differences were reported with Venham scores of paediatric patients in the ART group compared to those in the

MCP group during the application of the matrix and at the end of the treatment, the (P = 0.054 and 0.051, respectively). In addition, Schriks et al[88] reported that heart rate measurements of the paediatric patients during the treatment showed no significant differences between both ART and MCP groups except during the deep excavation phase (P = 0.03).

Table 5 Venham scores and heart rate measurement differences between ART and MCP groups during different treatment phases

Treatment phase	Goud et al[85]		Schriks et al[88]	
	Venham score P value	Heart rate - P value	Venham score P value	Heart rate - P value
Entrance	0.1801		0.153	0.256
Start	0.00000*		0.000	0.153
Deep excavation	0.00000*		0.000	0.030
Matrix	0.09048		0.054	0.296
Restoration	0.01495*		0.028	0.483
End	0.19368		0.051	0.521
Peak	-		0.002	-
Overall	0.00000*		0.000	-

P< 0.05= Statistically Significant
**Statistically significant*

Roshan et al examined the effectiveness of occlusal ART restorations in primary molars in 5-7-year-old paediatric patients in a split mouth design RCT.[59] In this study, each child received two ART restorations: one performed in the school environment and one performed in a pedodontic dental clinic setup. Modified VAS and heart rate were used to assess DA at five different ART procedure phases: child entering the treatment room, at the start of cavity excavation, at the moment of deepest excavation, at the moment of tooth restoration, and after completion of treatment. It was reported that higher Venham scores and heart rate were observed in paediatric patients treated in hospital dental set up compared to those treated in the school environment during the first two phases of the treatment, which was statistically significant as seen in Table 6. A similar trend was observed during the next phases of the treatment; however, the differences were not significant.[59]

Table 6 Venham score differences between two treatment groups during different treatment phases: school environment vs pedodontic dental clinic setup

Treatment phase	Venham score chi-square P value	Heart rate - P value
Entrance	0.023	0.037

Start	0.011	0.029
Deep excavation	0.061	0.057
Matrix	-	-
Restoration	0.058	0.073
End	0.090	0.082
Peak	0.073	-
Overall	0.061	-

van Bochove et al examined differences in discomfort levels during treatment with the ART or the CRT with and without local analgesia (LAg) in 300 children (144 boys and 156 girls, mean age 6.98 (SD±0.52)) aged between 6-7 years in Suriname with at least one small proximal lesion and from the occlusal surface in a primary molar, accessible for hand instruments.[90] The paediatric patients were randomly allocated into four treatment groups: CRT without LA, ART without LAg, CRT with LAg, and ART with LAg. Discomfort levels (using Venham scale) and heart rate were assessed at different phases of the treatment: at entrance in the treatment room, during local analgesia (in groups 2 and 4), at the start of preparation, during deep excavation, during application of the matrix and wedge, at the start of restoration (when glass ionomer cement was applied), and at the end of restoration Table 7.[90]

Venham scores for the four treatment groups are presented in Table 7, which showed significant differences at different stages of the treatment. Following the first treatment session, another treatment session was conducted that involved 109 children (56 boys and 53 girls) who were treated. No significant difference was found for the Venham scores or the heart rate measurements between the four groups at entrance into operating room (Table 7).[90]

Table 7 Differences in comfort levels - Venham scores and heart rate measurements following two treatment sessions

First treatment session		
Entrance	**Venham score Comfort Most to Least**	**Heart rate Comfort Most to Least**
1 entering clinic	C ~A~CL~AL	C~A~CL~AL
2 during local analgesia	AL>CL	CL>AL
3 start cavity preparation	A>AL>C>CL *	A>AL>CL>C
4 during deep excavation	A>AL>CL>C *	A>CL~C>AL
5 during application of matrix and wedge	AL>CL>A>C *	CL>C>A~AL
6 start restoration	AL>CL>A>C *	CL>C>A~AL
7 end of restoration	AL>CL>A>C	CL> C~A~AL

8 peak score	A>AL>C>CL *	A~C>CL~AL
9 overall score	A>AL>C>CL *	CL>A>C>AL
Second treatment session		
Entrance	**Venham score Comfort Most to Least**	**Heart rate Comfort Most to Least**
1 entering clinic	C ~A~CL~AL	C~A~CL~AL
2 during local analgesia	AL>CL	AL>CL
3 start cavity preparation	A>AL>C>CL *	A>AL>C>CL *
4 during deep excavation	C>A>CL>AL	A>C>CL>AL
5 during application of matrix and wedge	AL>A>CL>C	A>C>CL~AL
6 start restoration	A>AL>CL>C	C>A>CL~AL
7 end of restoration	A>AL>CL>C	A>C>CL>AL
8 peak score	A>C>AL>CL *	A>C>AL>CL *
9 overall score	A>C>AL>CL *	A>C>AL>CL

*[C=Conventional Restorative Treatment without LA; A=ART without LA; CL=Conventional Restorative Treatment with LA; AL=ART with LA] [LA= local analgesia). [> = Better than; * = significant difference; ~ = almost equal].*

Arrow et al conducted a stratified block RCT including 254 children with early childhood caries to compare ART with CRT. Dental fear levels were assessed using a dental fear and anxiety schedule in childrens' parents, and a faces child dental fear scale in children.[49] As seen in Table 8 results indicated that there was no significant change in level of dental fear in paediatric patients from baseline to follow up (12.5% vs 10.1%); however, the percentage of paediatric patients reporting more severe dental fear was significantly higher in the CRT group.

Table 8 Dental fear levels, overall and within groups

Factor	**Total**	**Test (ART) n = 127 (% or mean and 95% CI)**	**Control (CRT) n = 127 (% or mean and 95% CI)**
Parent fear	16.7 (15.5 - 17.8)	17.3 (15.6 -19.1)	16.0 (14.5 -17.5)
Child fear % Afraid	11.4% (6.9 -15.9)	12.5% (6.1 -18.9)	10.1% (3.8 -16.5)

Two studies reported discomfort levels which included both anxiety and pain in patients who underwent ART when compared to MCP or CRT (Table 9). van Amerongen et al (1999) in their RCT included 359 patients, aged between 6-16 years of age (mean age: 11.6 years) from seven schools in Karachi, Pakistan, who had two or more one-surface carious cavities and were treated by five dentists.[92] Table 9 presents data on discomfort levels reported by the patient during the two treatment sessions. It was found that in the ART group, patients who reported no discomfort during the first session also reported no discomfort during the second session (95%). Likewise, 70% of patients who reported discomfort during the first treatment session also reported discomfort during the second. A similar trend was observed in the MCP group where 83% of patients failed to report discomfort during both the treatment sessions and 66% reported discomfort during both

treatment sessions (chi-square: 84.5, P = 0.00 and chi-square: 44.3, P = 0.00 respectively for the ART and MCP groups).

Luz et al conducted a RCT including 30 paediatric patients, aged between 4-7 years who received dental treatment at a Dentistry School in Brazil.[91] The study compared ART with CRT (using local anaesthesia, rubber dam, rotary instruments and cavity filling with composite resin). Facial image scale (FIS) was used to assess discomfort levels, which included anxiety and pain and acceptability of the two treatments. No significant difference was observed between the two treatments groups regarding changes in FIS scores, although, there was a slight trend towards ART, wherein patients felt less discomfort. It was further reported that fifty percent of the paediatric patients in the ART group were more satisfied after the treatment, whereas 64% of the participants in the CRT Group did not report any change in their feelings towards treatment, which showed a borderline p value in the difference between the two treatments (Table 9).[91]

Table 9 Discomfort levels in patients treated with art compared to MCP/CRT

van Amerongen et al[92] - Frequency distribution of patients treated with either ART or MCP according to discomfort reported during first or second treatment				
Treatment approach	**Discomfort during first treatment**	**Discomfort during second treatment n (%)**		**Total**
		No	**Yes**	
ART	No	137 (95)	7	144
	Yes	11	26 (70)	37
	Total	148	33	81
MCP	No	94 (83)	19	113
	Yes	22	43 (66)	65
	Total	116	72	178
Luz et al[91] - Number of paediatric patients (percentage) demonstrating changes on FIS scores in the two groups (-1=satisfied; 0=no change; +1=unsatisfied)				
	Treatment Group			
FIS Difference	**ART n (%)**		**CRT n (%)**	
-1	8 (50.0%)		2 (14.3%)	
0	4 (25.0%)		9 (64.3%)	
1	4 (25.0%)		3 (21.4%)	
Proportion of paediatric patients' responses to "Did you feel any pain or discomfort during the treatment?"				
	Treatment Group			
Pain	**ART n (%)**		**CRT n (%)**	
No	6 (37.5%)		8 (57.1%)	
Yes	10 (62.5%)		6 (42.9%)	

Atraumatic Restorative Treatment (ART) – Adult Patients

Mickenautsch et al reported on DA levels in adult patients in a study conducted in South Africa that compared ART with CRT. Dental anxiety was measured by the CDAS and it

was reported that mean dental anxiety score (DAS) for adults in the ART group was 6.7 (SE = 0.4), which was statistically significantly (P = 0.001) lower than that for adults in the CRT group (9.3, SE = 0.2).[87]

4.4.2.2. Chemo-Mechanical Caries Removal (CMCR) – Paediatric and Adult Patients

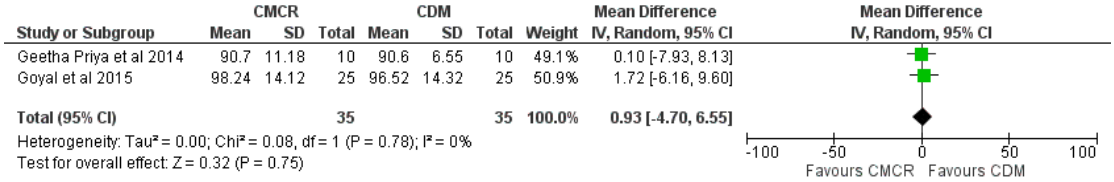
Three[50, 51, 60] out of six studies included in the review evaluated CMCR that used Carisolv gel; two studies[52, 86] used Papacarie (papain gel) and one study[84] used Carie care as the chemo-mechanical agent. One study (Rafique et al 2003) included both paediatric and adult patients.[60] All the six studies reported on anxiety levels following CMCR approach using various products when compared to CDM. Three studies[50, 51, 86] reported on pain levels and three studies[50, 51, 84] reported on patients' acceptance/rating of CMCR in addition to reporting on anxiety levels. The results below have been categorized based on the outcome of interest: DA, pain and patient acceptance/rating of the treatment.

Dental anxiety

Two studies (Geetha Priya et al 2014, Goyal et al 2015) were included in meta-analyses (Figures 8, 9 & 10) that compared CMCR with CDM at different points of time during the procedure, i.e. before, during and after the procedure to reduce DA levels in terms of mean pulse rate/minute.[84, 86] In a crossover RCT by Geetha Priya et al including paediatric patients (aged 7-11 years), it was reported that the pulse rates were not significantly different between both the treatment groups measured at different time intervals (as seen in Figures 8,9,&10).[84] Carie Care product was used in CMCR treatment. In a randomised, controlled and cross over clinico-microbiological study by Goyal et al that compared CMCR using Papacarie (Papain gel) product with CDM to reduce DA, it was reported that mean pulse rate significantly reduced both during and after caries removal in CMCR-Papacarie® method (from 98.24 to 89.64/min and from 89.64 to 85.12/min respectively, $p<0.05$).[86] As seen in Figure 8, the mean pulse rates were similar for both the groups ($p>0.5$) before the start of the procedure. In the CDM group there was a slight rise in mean pulse rate during treatment ($p>0.1$) but the pulse rate declined after the treatment, although it was not significant ($p>0.1$), as seen in

Figures 9 and 10. In comparison, the mean pulse rate significantly ($p<0.001$) declined in CMCR-Papacarie® treatment, both, during and after the procedure. It did suggest that none of the patients in CMCR-Papacarie® method had a rise in pulse during or after the procedure when compared to as many as 19 and 16 patients respectively during and after CDM.

Figure 8. Mean difference in pulse rate/min before caries removal



Goyal et al 2015 – CMCR using (Papacarie - Papain gel)

Geetha Priya et al 2014 – CMCR using (Carie Care)

Figure 9. Mean difference in pulse rate/min during caries removal

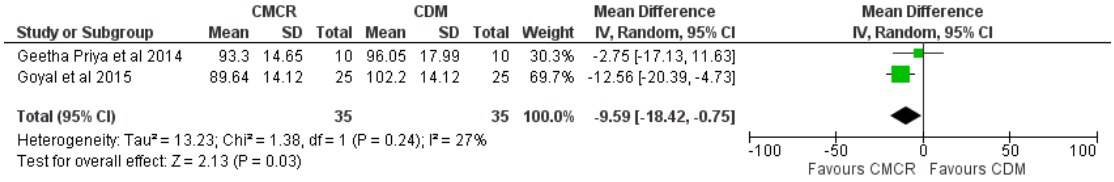
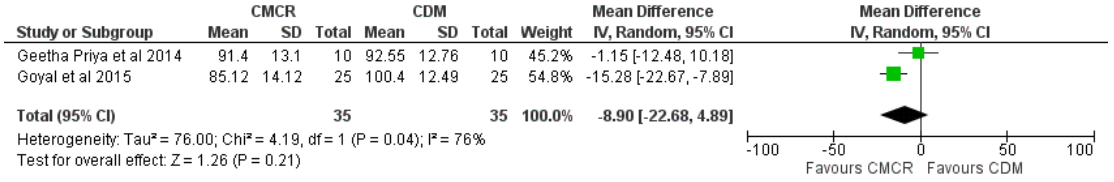


Figure 10. Mean difference in pulse rate/min after caries removal



In addition, as shown in Table 10, the study by Geetha Priya et al reported that the mean systolic and diastolic blood pressure were not significantly different between both the treatment groups measured at four different time intervals.[84]

Table 10 Comparison of systolic and diastolic blood pressure at 4 time intervals

Group	**Systolic pressure (Mean ± SD, P value)**			
	Pre-treatment	During treatment	Post-treatment	5 mins after treatment
CDM	95.20±9.76, 0.99	98.30±13.14, 0.58	96.75±11.41, 0.63	96.50±14.46, 0.38
CMCR	95.15±10.98	96.20±10.43	95.10±10.05	93.20±7.87
Group	**Diastolic pressure (Mean ± SD, P value)**			
	Pre-treatment	During treatment	Post-treatment	5 mins after treatment
CDM	56.60±5.68, 0.83	60.10±8.76, 0.58	57.90±9.51, 0.96	58.80±7.50, 0.59
CMCR	56.95±4.88	58.50±9.15	57.75±9.41	57.50±7.52

Three studies compared CMCR using Carisolv gel with CDM.[50, 51, 60] A parallel, open-label RCT conducted by Bergmann et al evaluated operator's rating of patient's anxiety during and after treatment, patient interview as well as at six-month follow up visit, and patients' experiences of the procedure.[50] As presented in Table 11, there were more patients who were relaxed after CMCR with Carisolv compared to those who underwent CDM. The results also suggested that more patients were 'very afraid' during drilling than CMCR, which was found to be significant. The paediatric patients in the CMCR group were on average about one year younger than those in the CDM/TM group, which might explain a tendency for the paediatric patients in the CMCR group to show poorer behaviour during the treatment compared with those in the CDM/TM group, and therefore might have affected the paediatric patients' responses in the two groups.

Rafique et al in a quasi-experimental study evaluated CMCR-Carisolv gel and air-abrasion compared to CDM using LA to treat caries in 22 patients (aged 13-75 years).[60] Participants' pre-operative anxiety levels were measured using the MDAS and VAS. Ninety-five percent of the participants in the CMCR group perceived that this treatment method using Carisolv gel technique was a less time-consuming technique as indicated in Table 11, when compared with CDM using local anaesthetic and dental drill. Overall, participants reported low levels of anxiety/dislike of air-abrasion and CMCR-Carisolv gel in comparison to those in the CDM group. Further, it was reported that 23% of the participants in the CDM group scored high anxiety levels on both the pre-operative MDAS and postoperative VAS scales, whereas in comparison, none of the participants in the CMCR-Carisolv and air-abrasion groups reported high levels of anxiety.

In a split mouth RCT by Inglehart et al that evaluated CMCR for treating dentinal depth occlusal lesions with minimal enamel access in primary molars in relation to paediatric patients' (6-11 years) happiness and fear before and after their dental appointment, their perception of the time needed and the pain they experienced, it was reported that fear of the dentist increased in subjects in the CMCR group before to after the operative appointment when compared to those in the CDM/Traditional method (TM) group.[51] Dental fear was measured with CFSS-DS. Table 11 presents data on operator's and patient's responses to CMCR AND CDM/TM. As seen in the table, the operator perceived that the patients in the CMCR group were less well-behaved when compared to those in the CDM/TM group, both during caries removal (2.88 vs 3.38, P = .07), and during resin-based composite restoration placement (3.09 vs 3.57, P = .05) respectively.

Table 11 Anxiety levels in patients treated with CMCR using Carisolv gel vs CDM

Bergmann et al[50] - Patient reaction – dentists' rating of anxiety						
	Carisolv (N = 46)			**Drilling (N = 46)**		
	Before	During	After	Before	During	After
Relaxed	27	19	34	25	13	31
Anxious	15	24	12	19	20	14
Very afraid	4	3	0	2	13	1

Rafique et al[60] - Postoperative VAS anxiety scales for conventional and alternative treatment methods									
Variables	**Low anxiety/dislike n (%) VAS1 VAS 2**			**Moderate anxiety/dislike n (%) VAS 3 VAS 4**			**High anxiety/dislike n (%) VAS 5 VAS 6**		
	CDM	**CMCR**	**Air-abrasion**	**CDM**	**CMCR**	**Air-abrasion**	**CDM**	**CMCR**	**Air-abrasion**
Postoperative anxiety (P< 0.001)	1 (4%)	20 (91%)	19 (86%)	16 (73%)	2 (9%)	3 (14%)	5 (23%)	0	0
Pain on injection/gel/air-abrasion (P< 0.001)	1 (4%)	20 (91%)	18 (82%)	15 (68%)	2 (9%)	4 (18%)	6 (28%)	0	0
Time taken (P< 0.001)	0	21 (95%)		20 (91%)	1 (4%)		2 (9%)	0	

Inglehart et al[51] - Dentist/Operator's and Patient responses to CMCR and CDM/TM			
Dentist/Operator's responses to CMCR and CDM/TM			
Responses	**CMCR (n = 26)**	**CDM/TM (n = 24)**	**P value**
Frankl Behaviour Rating Scale score during caries removal (4-point)	2.88	3.88	0.07
Frankl Behaviour Rating Scale score during composite placement (4-point)	3.09	3.57	0.05
Patient's responses to CMCR and CDM/TM			
Responses	**CMCR (means)**	**CDM/TM (means)**	**P value**
Change in overall dental fear, baseline to posttreatment (4-point)	Pretreatment: 1.76 Posttreatment: 1.77	Pretreatment: 1.84 Posttreatment: 1.83	NS
Change in fear of the doctor, baseline to posttreatment (4-point)	Pretreatment: 1.34 Posttreatment: 1.84	Pretreatment: 1.30 Posttreatment: 1.17	0.040
Change in fear of the sound of the drill, combined treatment groups (4-point)	Pretreatment: 2.04 Posttreatment: 1.53	0.038	
Change in fear of a dental cleaning, combined treatment groups (4-point)	Pretreatment: 1.46 Posttreatment: 1.16	0.064	

Two studies assessed anxiety levels in terms of behavioural responses to CMCR when compared to CDM (Table 12).[52, 84] In a RCT by Maru et al that assessed paediatric patients' (aged 3-5 years) behavioural responses to caries removal with and without using rotary instruments (CDM vs CMCR using Papacarie), it was found that children in the CMCR group experienced relaxed behaviour compared to those in the CDM group.[52] Paediatric patients' behaviour was assessed using the MCDAS during four different treatment phases. The paediatric patients divided in two groups received both the treatments alternatively on contralateral teeth. The first group (Group 1) received CDM for the affected tooth followed by CMCR on the contralateral tooth and in the second group (Group 2), children first received CMCR treatment followed by CDM treatment on the contralateral tooth, in the same visit. Papacarie consists of 10% papain, 0.5% chloramine‑T, toluidine blue, salts, and a thickening agent.

Behaviour of paediatric patients in group I at phase 1 of treatment was not found to be statistically significant; at phase 2 of treatment, strong statistical significance (P = 0.002) was found with respect to scale 1 of MCDAS and moderate statistical significance (P = 0.042) was found with respect to scale 3 of MCDAS; phase 3 of treatment did not show any statistically significant result and phase 4 of treatment showed moderate statistical significance (P = 0.015) with respect to scale 1 of MCDAS. The evaluation of behaviour in group 2 at phase 1 of treatment was found to show moderate statistical significance (P = 0.043) with respect to scale 1 and scale 2 of MCDAS. At phase 2 of treatment, no statistically significant result was found. Further, the results show moderate statistical significance during phase 3 (P = 0.023) with respect to scale 1 of MCDAS and phase 4 (P = 0.012) with respect to scale 1 and scale 2 of MCDAS.[52] In the study by Geetha Priya et al, there was no statistically significant difference in behavioral response of child during CDM and CMCR procedures.[84]

Table 12 Behavioural response of paediatric patients treated with CMCR vs CDM

Maru et al[52]			
Mean score behaviour of paediatric patients in group 1 between CDM-Rotary and CMCR-Papacarie (mean ± SD)			
Treatment phase	**CDM-Rotary**	**CMCR-Papacarie**	**P value**
5 mins before start of treatment	1.44±0.51	1.25±0.45	0.381
During caries removal	2.44±0.89	1.38±0.50	<0.001
Following cavity filling	2.50±0.96	1.75±0.46	0.023
5 mins after completion of the entire treatment procedure	2.19±0.86	1.50±0.52	0.010

Mean score behaviour of paediatric patients in group 2 between CMCR-Papacarie and CDM-Rotary			
Treatment phase	**CMCR-Papacarie**	**CDM-Rotary**	**P value**
5 mins before start of treatment	1.31±0.49	1.00±0.00	0.138
During caries removal	1.81±0.98	1.75±0.45	0.724
Following cavity filling	1.94±0.44	1.44±0.51	0.023
5 mins after completion of the entire treatment procedure	1.75±0.45	1.25±0.45	0.015

Geetha Priya et al[84]									
Paediatric dentist's assessment	Group								P value
		F	L	A	C	C	Total	Mean±SD	
Behavioural response of child	CDM	10	3	0	0	0	13	0.64±0.88	0.076
	CMCR	5	0	0	0	0	5	0.25±0.44	

* CMCR: Chemomechanical caries removal. † TM: The traditional caries removal method using a round bur. ‡ 5-point scale in which 1 = least and 5 = most. § Source: Frankl and colleagues.21 ¶ 4-point scale in which 1 = definitely negative and 4 = definitely positive. # NS: No statistically significant difference. ** 3-point scale in which 1 = short time and 3 = very long time. †† Cont: Continuous 100-millimeter scale in which 0 = worst hurt and 100 = no pain.

Pain

Three studies assessed pain in addition to anxiety levels when comparing CMCR with CDM, the findings of which are presented in Table 13.[50, 51, 86] Bergmann et al also reported data on the patient's and dentist's rating of pain of the procedure.[50] As can be seen in Table 13 the degree of pain, as rated by the dentist, was less for the CMCR-Carisolv treatment compared to CDM ($p < 0.05$), which corresponded to the patients' own ratings as well, which was a non-significant difference ($p > 0.05$). In the study by Goyal et al CMCR using Papacarie product was compared with CDM to reduce anxiety, pain and overall acceptance of treatment.[86] Treatment related pain was assessed by Wong-Baker-FACES (WBF) scores. Table 13 presents data for mean pulse rates and WBF scores for the two groups. As seen in Table 13, the pain scores on the WBF Scale prior to procedure were similar for the two treatment methods ($p>0.5$). However, as with pulse rates, there was a slight rise in mean WBF scale score, both, during and after the procedure in CDM group ($p>0.5$) when compared to those in the CMCR-Papacarie® group, where there was a significant ($p<0.01$) decline both during and after the completion of procedure. This showed that the pain that existed before the start of the procedure declined during and after caries removal by CMCR-Papacarie® method but pain increased, both, during and after the procedure in the CDM group.

In a split mouth RCT by Inglehart et al that evaluated CMCR for treating dentinal depth occlusal lesions with minimal enamel access in primary molars in relation to paediatric

patients' (6-11 years) happiness and fear before and after their dental appointment, their perception of the time needed and the pain they experienced, it was reported that fear of the dentist increased in subjects in the CMCR group before to after the operative appointment when compared to those in the CDM/Traditional method (TM) group.[51]

Table 13 Pain levels in patients treated with CMCR vs CDM

Bergmann et al[50] - Dentists' and patients' rating on pain				
	Carisolv (N = 46)		**Drilling (N = 46)**	
	Dentist	Patient	Dentist	Patient
No pain	27	26	19	18
Little pain	19	17	16	17
Much pain	0	1	9	4
Very much pain	0	1	2	6
Do not know	0	1	0	1
Goyal et al[86] - WBF scores before, during and after the procedure in the two groups				
Parameter	**CDM**		**CMCR**	
Mean WBF score				
Before	5.12±2.01		5.28±1.28	
During	6.16±1.91		3.44±1.36	
After	5.76±1.76		2.24±1.45	
Inglehart et al[51] - Dentist/Operator's and Patient responses to CMCR and CDM/TM				
Dentist/Operator's responses to CMCR and CDM/TM				
Responses	**CMCR (n = 26)**		**CDM/TM (n = 24)**	**P value**
Perceived patient pain (4-point)	2.77		2.42	NS¶
Patient's responses to CMCR and CDM/TM				
Responses	**CMCR (means)**		**CDM/TM (means)**	**P value**
Experienced intraoperative pain (Cont††)	69.71		61.12	NS

* CMCR: Chemomechanical caries removal. † TM: The traditional caries removal method using a round bur. ‡ 5-point scale in which 1 = least and 5 = most. § Source: Frankl and colleagues.21 ¶ 4-point scale in which 1 = definitely negative and 4 = definitely positive. # NS: No statistically significant difference. ** 3-point scale in which 1 = short time and 3 = very long time. †† Cont: Continuous 100-millimeter scale in which 0 = worst hurt and 100 = no pain.

Patient's acceptance/rating of treatment

Bergmann et al evaluated operator's rating of patient's anxiety during and after treatment, patient interview as well as at six-month follow up visit, and patients' experiences of the procedure.[50] As presented in Table 14, there were more patients who were relaxed after CMCR with Carisolv compared to those who underwent conventional drilling method (CDM). It was also found that a significantly ($p < 0.05$) higher number of patients rated CMCR-Carisolv treatment 'good' or 'OK' than the CDM as seen in Table 14. It was also reported that if patients came next time for treatment, 65% would

choose Carisolv treatment, 0% drilling, 13% not minding either with the remaining 22% not stating their preference.

In the study by Inglehart et al, it was reported that fear of the dentist increased in subjects in the CMCR group before to after the operative appointment when compared to those in the CDM/Traditional method (TM) group.[51] As seen in Table 14, both the operator and the patients in the CMCR group were less satisfied with the treatment compared with the CDM/TM group (2.62 vs 4.00, P < .001 and 2.96 vs 3.46, P = .095 respectively) as perceived by the operator. The operator rated the paediatric patients' satisfaction with the treatment on a four-point scale in which. In relation to paediatric patients' responses to the treatments, the study found that subjects in the CMCR group perceived the time spent in the chair as being significantly longer compared to those in the CDM/TM group; 1.77 vs 1.33, P = .033. However, patients in the two groups did not differ in their posttreatment happiness, their satisfaction with the treatment, their experienced intraoperative pain and their overall fear scores.[51]

In the crossover RCT by Geetha Priya et al it was found that the paediatric patients in the CDM group (17.5%) reported a significant (P = 0.025) increase in discomfort level (as assessed by the FIS) compared to those in the CMCR group (0%).[84] Carie Care product was used in CMCR treatment. However, there were no significant differences between the two treatment groups in relation to treatment type preference and overall acceptance.

Table 14 Patient's acceptance/rating of CMCR and CDM

Bergmann et al[50] - Patient's reaction - acceptance/rating of treatment			
	Carisolv (N = 46)	**Drilling (N = 46)**	
Good	17	9	
Ok	18	11	
Not so good	4	14	
Awful	5	10	
Do not know	2	2	
Inglehart et al[51] - Dentist/Operator's and Patient responses to CMCR and CDM/TM			
Dentist/Operator's responses to CMCR and CDM/TM			
Responses	**CMCR (n = 26)**	**CDM/TM (n = 24)**	**P value**
Operator satisfaction with treatment (5-point)	2.62	4.00	0.001
Perceived patient satisfaction (5-point)	2.96	3.46	0.095
Perceived patient pain (4-point)	2.77	2.42	NS¶
Patient's responses to CMCR and CDM/TM			
Responses	**CMCR (means)**	**CDM/TM (means)**	**P value**
Perceived treatment time (3-point**)	1.77	1.33	0.33

Posttreatment happiness (5-point)	4.15	4.50	NS
Satisfaction with the treatment (4-point)	3.46	3.96	NS

Geetha Priya et al[84] - Patient's response to discomfort, preference and overall acceptance to treatment/s

Patient response	Group	Facial Image Scale (%)					P value
		Score 1	Score 2	Score 3	Score 4	Score 5	
Discomfort	CDM	25	0	2.5	5	17.5	0.025
	CMCR	32.5	0	10	7.5	0	
Preference	CDM	25	0	2.5	12.5	10	0.931
	CMCR	25	0	5	10	10	
Overall acceptance	CDM	22.5	5	0	10	12.5	0.528
	CMCR	27.5	2.5	0	15	5	
	CMCR	5	0	0	0	0	5	0.25±0.44	

* CMCR: Chemomechanical caries removal. † TM: The traditional caries removal method using a round bur. ‡ 5-point scale in which 1 = least and 5 = most. § Source: Frankl and colleagues.21 ¶ 4-point scale in which 1 = definitely negative and 4 = definitely positive. # NS: No statistically significant difference. ** 3-point scale in which 1 = short time and 3 = very long time. †† Cont: Continuous 100-millimeter scale in which 0 = worst hurt and 100 = no pain.

ART vs ART+CMCR

Topaloglu-Ak et al evaluated DA levels among 6-7-year-old paediatric patients treated restoratively in primary molars in a modern dental clinic between the ART approach and ART aided with a chemomechanical caries removal gel.[89] The chemomechanical caries removal gel (Carisolv™) was applied on carious dentine for 30 seconds after the cavity had been accessed by hand instruments. The prepared cavities were restored and finished in the same way as described for the ART procedure. The paediatric patients' level of anxiety was assessed using the VPT. Table 15 presents the mean VPT scores and standard deviations for the use of the ART approach in combination with and without a chemomechanical caries removal gel by operators. No statistically significant difference (p=0.07) was observed between the mean VPT scores for the use of ART with and without a chemomechanical caries removal gel. However, an operator effect was observed. The mean VPT scores for operator 4 were statistically significantly (p=0.002) higher than those for the three other operators. Girls treated through ART in combination with a chemomechanical caries removal gel had higher mean VPT scores (p=0.01) than boys.[89]

Table 15 The mean Venham picture test (VPT) scores and standard deviations for the use of the ART approach with and without a chemomechanical caries removal gel by operators

Operator	ART		ART + CMCR	
	N	Mean ± SD	N	Mean ± SD
1	34	1.6 ± 1.9	31	0.7 ± 1.2
2	36	1.5 ± 1.6	32	1.4 ± 1.8
4	33	2.6 ± 2.2	36	1.8 ± 1.8
5	55	1.2 ± 1.7	51	1.3 ± 1.9
Total	158	1.7 ± 1.9	150	1.3 ± 1.7

Table 16 Assessment of methodological quality (ART and CMCR)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Arrow & Klobas 2015	RCT	U	N	N	Y	N	Y	Y	Y	Y	Y	I	5
Bergmann et al 2005	RCT	U	N	N	U	N	Y	Y	Y	N	Y	I	4
De Menezes Abreu et al 2011	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Geetha Priya et al 2014	Crossover RCT	Y	N	U	N	N	Y	Y	Y	Y	Y	I	6
Goud et al 2012	RCT	Y	Y	N	N	Y	Y	Y	Y	Y	Y	I	8
Goyal et al 2015	RCT	U	N	N	N	N	Y	Y	Y	U	Y	I	4
Inglehart et al 2007	RCT	U	N	N	N	N	Y	Y	Y	Y	U	I	4
Luz et al 2012	RCT	U	U	Y	Y	Y	Y	Y	Y	Y	Y	I	8
Maru et al 2014	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Mickenautsch et al 2007	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Rafique et al 2003	RCT	U	N	U	N	N	Y	Y	Y	Y	Y	I	5
Roshan & Sakeenabi 2012	Split mouth RCT	U	N	N	N	Y	Y	Y	Y	Y	Y	I	6
Schriks & Amerongen 2003	RCT	U	Y	N	N	N	Y	Y	Y	Y	Y	I	6
Topaloglu-Ak et al 2007	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
van Amerongen & Rahimtoola 1999	RCT	U	U	U	N	U	N	Y	Y	U	Y	E	3
van Bochove & van Amerongen 2006	RCT	U	U	U	N	U	Y	Y	Y	Y	Y	I	5

4.4.3. Audiovisual (AV)

Thirty-eight studies including 26 parallel group RCTs, one crossover RCT, one split mouth RCT, nine quasi experimental studies and one cross-sectional study were included in this review.[58, 70, 72, 74, 93-127]

Audio/Music

Music in children

Aitken et al conducted a quasi-experimental study that investigated the effects of music distraction on anxiety and behaviour in 45 patients aged between 4 to 6 years who underwent restorative dental treatment with LA and were divided into three equal groups: upbeat music distraction (A Child's Celebration of Folk Music by various artists, 1996), relaxing music distraction (slow, lulling instrumental music (In the Enchanted Garden by Kevin Kern, 1996)), and no music control.[58] In relation to parental perception of patient's anxiety, the mean Corah score was 7.5 for visit 1 and 7.8 for visit 2. 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 (Table 17). 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.[58]

Table 17 Self-reported anxiety measurements, Venham picture scale (one-way ANOVA)

	Upbeat Music	**Relaxing Music**	**No Music**	**F**	**P value**
Visit 1					
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
Visit 2					
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

Marwah et al conducted a RCT that 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.[115] Forty children aged between 4 and 8 years with no previous dental experience 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). Patient anxiety level in each visit was assessed by a combination of four measures, which included VPT, VARS, PR and oxygen saturation. 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 latter group (Table 18). Control group showed higher pulse rate compared to both the music groups; however, the differences were not statistically significant. There was a statistically significant difference between the pulse rates in 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.[115]

Table 18 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

In a RCT, Navit et al 2015 compared the efficacy of audio-distraction aids in reducing the anxiety of paediatric patients while undergoing various stressful and invasive dental procedures in 150 children (aged between 6 to 12 years).[120] The intervention groups included the instrumental music group, the musical nursery rhymes group, the movie songs group and the audio stories group. A control group with no audio distraction was also included. Each patient had four visits and their anxiety levels were measured by the VPT, Venham's Clinical Rating Scale (VCRS) and pulse rate measurement (finger pulse oximeter). Results indicated that there was a significant difference between all the groups for the mean pulse rate, with an increase in subsequent visit; however, no significant differences were seen in the VPT & VCRS scores between all the groups. Overall, audio aids reduced DA when compared to the control group, with the most significant reduction in anxiety level observed in the audio stories group (Table 19).[120]

Table 19 Intergroup comparison of pulse rate, VPT, VCRS for combined visits

	Control A		**Group I B**		**Group II C**		**Group III D**		**Group IV E**	
Pulse rate	97.85 ± 7.09		96.43 ± 4.03		95.76 ± 4.20		94.83 ± 5.77		93.57 ± 4.43	
VPT	1.92 ± 1.35		1.88 ± 0.93		1.64 ± 0.78		1.78 ± 0.99		1.51 ± 0.94	
VCRS	0.90 ± 0.73		0.96 ± 0.64		0.86 ± 0.57		1.03 ± 0.70		0.85 ± 0.68	
	Statistical Significance (p value)									
	A-B	A-C	A-D	A-E	B-C	B-D	B-E	C-D	C-E	D-E
Pulse rate	0.218	0.018	<0.001	<0.001	0.861	0.129	<0.001	0.648	0.011	0.333
VPT	0.394	0.318	0.924	0.056	0.100	0.637	0.083	0.257	0.237	0.381
VCRS	0.693	0.851	0.143	0.680	0.246	0.441	0.203	0.060	0.796	0.058

Jindal et al (2011) in a quasi-experimental study compared the effect of audio distraction with no audio distraction in 30 children aged between 4 and 8 years.[112] Children in the intervention group listened to music through headphones, which was based on their choice. Patients had four dental visits and DA was measured using VPT, which was administered two times to each patient, prior to each treatment session and immediately following the treatment on subsequent visits. The results showed that the mean sum of scores for the dental examination visit and the prophylaxis visit were similar in both the groups. However, during the restorative treatment visit and during the 4th (invasive procedure) visit, the mean sum of scores for control group and music group significantly differed ($p < 0.05$), with less anxiety scores in the music group compared to the control group; 6.57 and 5.56 and 5.07 and 4.38 respectively.[112]

Parkin in 1981 investigated the effect of playing ambient music on apparent anxiety in 25 children (aged between 7 and 14 years) during routine dental treatment involving cavity preparation.[70] All children were exposed to the sound of a standard musical tape consisting of light orchestral popular music with slow soothing rhythms. The results (Paired t test, $t = 2.1639$, $0.025 > p > 0.01$) showed that there was a significant reduction in anxiety when children were listening to music.

Music in adults

A RCT 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.[72] Eighty male and female patients

(between 18 and 65 years of age) were randomly assigned to eight groups: LA only (male and female, a & b), LA plus music (male and female, c & d), LA plus nitrous oxide/oxygen (male and female, e & f) and LA 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 western and light contemporary hits). Prior to the dental treatment, S-IgA levels were analysed by radio immunodiffusion. Music listening alone significantly reduced ($p = 0.0113$) the level of stress in female patients and in contrast in male patients there was no significant difference (Table 20).

Table 20 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

A RCT 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.[74] Participants were randomly assigned to a music treated group (106 subjects) and a control group (113 subjects). The mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) varied significantly with surgical stage for both groups and there were no significant differences in SBP or DBP between the music treatment group and control group. Similarly, HR and 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 21).

Table 21 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*

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 (Table 22).[74]

Table 22 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	4.226/0.41*

(F = analysis of variance, *P < 0.05)

Hui-Ling Lai et al conducted a block RCT to investigate the effect of music on anxiety during root canal treatment in 44 subjects between 20 and 65 years of age. Participants were randomised to music (n=22) and control group (n=22).[114] Participants in the music group were exposed to a wide variety of soothing piano music through headphones with adjusted volume. Procedure-related anxiety was measured using the 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 was a significant difference ($p < 0.001$) in state anxiety scores between music group and control group, anxiety levels being higher in the latter group as seen in Table 23. Participants in the music group showed significantly better scores for FT and HR over five data points. There were no significant differences between both the groups in relation to HR, SBP and DBP.[114]

Table 23 State of anxiety and FT parameter: means by group and time

Time	**Music**	**Control**	**t test**	**95% CI**
State anxiety				
Pretest	50.64 ± 5.10	49.73 ± 5.49	0.57	-2.32, 4.13
Immediately after treatment	32.80 ± 3.61	39.55 ± 5.16	-5.01***	-9.44, -4.01
Finger Temperature				
Pretest	30.31 ± 2.67	30.21 ± 2.59	0.90	-1.50, 1.70
Immediately after treatment	34.43 ± 1.13	32.56 ± 2.59	3.08**	0.64, 3.08

(**p < 0.01, ***p < 0.001)

Thoma et al conducted a RCT involving 92 consecutive volunteer patients waiting for their scheduled dental hygiene treatment and these patients were randomly allocated to either an experimental (n=46, listening to music for 10 min) or a control group (n=46, waiting in silence).[126] State anxiety levels in the music group decreased significantly after intervention as compared to the control group ($F(1/90)=8.06$; $p=0.006$). Participants' trait anxiety and DA were not found to moderate this effect. Listening to music prior to dental hygiene treatment decreased anxiety levels to a greater extent than waiting in silence. The mean trait DA in the music group was 34.6 (SD 9.85) compared to 31.76 (SD 9.34) in the control group. The study found that listening to music for 10 min was more effective in reducing state anxiety than waiting in silence.[126]

Cipolloni in a quasi-experimental study examined the effect of acoustic ambience on a patient's anxiety while waiting in an examination room for a dental procedure.[102] During the waiting period of 5 minutes, participants were exposed either to an acoustic ambience of ocean sounds from the clinic's audio system or remained in an ambience of silence. At the end of the waiting period and prior to the scheduled procedure, participants completed the 5-item State-Trait Anxiety Inventory-Short Form (STAI-SF). A non-significant reduced anxiety was reported by patients exposed to the ocean sounds.[102]

Di Nasso et al in a RCT evaluated the effect of music on physiological indices such as BP and HR before, during, and after restorative treatment in 100 patients (aged between 13 to 83 years) with different levels of anxiety assessed with the CDAS.[104] Patients were randomly divided into 2 groups: the music group and the control group with no music. Results showed that there was a significant ($p<0.05$) decrease in anxiety levels in the music group compared to the control group during and after the endodontic treatment (Table 24).[104]

Table 24 Mean and standard deviations for Diastolic Blood Pressure, Systolic Blood Pressure, and Heart Rate during and after root canal treatment by level of anxiety

Outcome	Time point	Level of anxiety at baseline measured with Cohen test	Mean ± Standard deviation	
			Music group	Control group
Diastolic BP	During root canal treatment	None (<4 score)	-8.8 (±8.086)	0.1 (±10.26)
		Mild (from 4–8 score)	-8.72 (±11.546)	-1.47 (±9.164)
		Moderate (from 9–12 score)	-3.61 (±13.353)	-0.8 (±12.583)
		Severe (>12 score)	-10.4 (±8.514)	1.03 (±2.036)
	After root canal treatment	None (<4 score)	0.52 (±9.206)	9.2 (±25.91)
		Mild (from 4–8 score)	3.12 (±10.93)	2.17 (±12.06)

		Moderate (from 9–12 score)	5.54 (±8.908)	4.39 (±16.672)
		Severe (>12 score)	0.57 (±9.128)	0.16 (±3.555)
Systolic BP	During root canal treatment	None (<4 score)	-9.11 (±9.188)	0.36 (±8.525)
		Mild (from 4–8 score)	-8.73 (±7.481)	1.21 (±7.487)
		Moderate (from 9–12 score)	-10.77 (±10.61)	0.07 (±12.992)
		Severe (>12 score)	-15.57 (±7.338)	-1.87 (±5.598)
	After root canal treatment	None (<4 score)	-5.01 (±9.599)	-1.29 (21.056)
		Mild (from 4–8 score)	-4.08 (±10.076)	0.58 (±7.688)
		Moderate (from 9–12 score)	-5.99 (±11.225)	2.81 (±13.918)
		Severe (>12 score)	-8.27 (±9.186)	-2.67 (±6.23)
Heart Rate	During root canal treatment	None (<4 score)	-10.55 (±8.006)	0.42 (±7.385)
		Mild (from 4–8 score)	-7.54 (±6.393)	0.64 (±7.425)
		Moderate (from 9–12 score)	-10.28 (±8.919)	-4.38 (±8.555)
		Severe (>12 score)	-11.88 (±10.118)	-4.85 (±6.841)
	After root canal treatment	None (<4 score)	-9.11 (±9.599)	2.1 (±15.894)
		Mild (from 4–8 score)	-3.2 (±8.662)	-0.48 (±10.893)
		Moderate (from 9–12 score)	-7.04 (±8.28)	-9 (±15.771)
		Severe (>12 score)	-10.11 (±11.822)	-1.1 (±3.795)

Jembulingam et al in a quasi-experimental study evaluated the effect of music on decreasing the BP in 15 adult patients who underwent dental surgeries.[110] The blood pressure was measured at rest position before the surgery, and then after the intervention was measured at an interval of 5 minutes for a duration of 15 minutes. The mean BP level of the patient, which was initially at 107/65 mmHg (with a HR of 74 beats/minutes) increased significantly to 116/68 mmHg (HR of 84 beat/minutes) 5 minutes after the music was played, which then decreased to a mean level of 108/61 mmHg at the end of 15 minutes during the surgery (HR of 76 beats/minutes). A statistically significant ($p<0.05$) change was observed in the systolic BP during the 10th and 15th minutes during the surgery with music played to the patient when compared to the systolic BP during the non-music phase before the surgery.[110]

Mejía-Rubalcava et al 2016 in a RCT that included 34 patients (aged>18 years) examined the effect of music therapy in patients with DA who attended to dental appointment. Patients were randomised into music and control groups.[116] Physiological indices measured included salivary cortisol, BP, HR, and oxygen saturation. At baseline, both the groups appeared to have the same level of anxiety; however, following the intervention, statistically significant differences were observed in salivary cortisol

concentration, systolic and diastolic BP, and HR for those in the music therapy group (Table 25).[116]

Table 25 Physiological variables by measurement and study group

Outcome	Before music therapy			After music therapy		
	Control group	Music therapy group	P value	Control group	Music therapy group	P value
Salivary cortisol (mg/dL)	1.2 ± 0.1	1.2 ± 0.2	0.79	1.3 ± 0.1	0.5 ± 0.9	0.001
Systolic BP (mm/Hg)	131.6 ± 4.6	131.7 ± 9.1	0.96	134.9 ± 6.2	122.5 ± 7.5	0.001
Diastolic BP (mm/Hg)	87.2 ± 4.7	86.5 ± 9.0	0.70	88.8 ± 6.5	74.9 ± 7.5	0.001
Heart rate (beats per minute)	84.5 ± 6.1	78.8 ± 10.5	0.06	87.9 ± 6.6	71.1 ± 5.6	0.01
Oxygen saturation (%)	96.0 ± 1.9	96.5 ± 1.5	0.95	96.5 ± 2.2	95.8 ± 1.6	0.331

In a RCT by Miyata et al the alleviating effect of music on preoperative anxiety by using heart rate variability (HRV) analysis was evaluated in 86 adult patients (classified as either fearful or nonfearful) scheduled to undergo impacted tooth extraction under intravenous sedation and LA.[118] Patients were divided into two groups: those who listened to music from the time that they arrived at the outpatient clinic until immediately before entering the operating room and those who did not listen to music. The low frequency/ high-frequency ratio of HRV enables to identify changes which indicate increased or decreased sympathetic nervous activity. The subjective preoperative anxiety was evaluated on a VAS. Results showed that the mean magnitude of low-frequency/high frequency changes from baseline among those who listened to music was significantly lower when compared to those who did not listen to music (in the private room: −1.45 ± 1.88 vs. 1.05 ± 1.88, p = 0.0096; in the operating waiting room: −2.18 ± 2.39 vs. −0.10 ± 3.37, p = 0.011, respectively). The VAS scores were also statistically significantly different between both the groups. The VAS scores for the private room period and operating waiting room period decreased significantly by 32% and 29% when compared to the baseline values in the fearful music group (28.0 ± 16.2 vs 41.0 ± 18.3 and 29.3 ± 19.0 vs 41.0 ± 18.3, respectively).[118]

Audiotaped stories

Ingersoll et al examined the effect of contingent audiotaped material (audiotaped stories) in 45 paediatric dental patients (aged 4-9 years) to reduce uncooperative behaviour.[109] Patients were assigned to three groups, control (routine restorative treatment), noncontingent group (chose audiotaped stories and heard through headphones throughout the dental treatment) and contingent group (patients were informed that the audiotaped material would be only available only if they remained quiet and cooperative). As seen in the Table 26, results indicated significant differences between the treatment groups and the control group on various parameters at visit 2.

Table 26 Mean scores for all groups at first and second restorative visits

Variable	Control group		Noncontingent group		Contingent group	
	1	**2**	**1**	**2**	**1**	**2**
Disruptive behaviour (%)	31.4	37.4	28.5	28.7	30.4	6.1
VPT	1.3	0.6	1.7	1.4	2.6	2.5
Dental fear	29.5	25.8	34.2	33.1	31.1	31.7

Audiovisual/Virtual reality/Eyeglasses

Adults

Affeldt-Devine (2006) in a RCT evaluated the effectiveness of an AV virtual reality system (VR) on the reduction of DA in 40 adult patients who underwent endodontic treatment.[93] Dental anxiety was assessed using the DAS; the DFS; and the DBS. Patients were randomly assigned to either a control or experimental group. The experimental group underwent endodontic treatment while viewing nature-related scenes with an AV VR system and the control group underwent endodontic treatment without the AV VR system. Results showed that the patients in the experimental group reported statistically significantly less anxiety compared to those in the control group ($t(18)=-2.15$, $p<0.05$).[93] Patients in the experimental group reported significantly lower DAS post-test scores compared to pre-test scores but there was no significant difference between the pre and post test scores in the control group (Table 27). In addition, the DBS results showed that there was a significant increase in positive interactions with the endodontist. However, patients in the experimental group did not report a significant reduction in dental fear/phobia, as measured by the DFS (Table 27).[93]

Table 27 Means and standard deviations of the DAS, DFS, and DBS (pre vs. post-test) by experimental versus control groups

	DAS		**DFS**		**DBS**	
	Experimental	Control	Experimental	Control	Experimental	Control
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Pre-test	2.54 ± 1.00	2.71 ± 1.01	2.43 ± 1.07	2.58 ± 1.05	2.54 ± 1.12	2.54 ± 0.96
Post-test	2.01 ± 0.67	2.75 ± 1.06	2.08 ± 0.78	2.62 ± 1.11	2.04 ± 0.74	2.30 ± 0.91

In a trial conducted by DeNitto that assigned 60 patients (aged >18 years) to either an intervention group (a relaxation movie was watched and listened to throughout the root canal procedure) or a control group (in which nothing was turned on and the video eyewear remained blank), it was reported that there were nonsignificant differences in pre-operative anxiety scores between the AV group was 5.73 (±1.96) and the control group was 6.03 (±2.04).[103] However, the mean reported post-operative anxiety score for the AV group (1.67 (±1.49)) was significantly ($P < 0.001$) different compared to control group (4.30 (±1.86)) and in addition, there was a significant ($P < 0.001$) difference in the mean change from pre-operative to post-operative anxiety score between the AV group was 4.07 (±1.75) and the control group was 1.73 (±1.75).

In a split mouth RCT by Padrino-Barrios[122] the effects of immersive visualisation (IV) eyewear on 30 moderately anxious (score 9 or higher on the Corah's Dental Anxiety Scale-Revised (DAS-R)), adult patients (aged ≥18 years) during a full mouth oral prophylaxis (supra- and subgingival scaling and selective polishing) was evaluated. The patients were randomly divided into 2 groups: Group A used IV eyewear during the first one-half of the appointment (right side of the mouth) and Group B used IV eyewear during the second one-half of the appointment (left side of the mouth) and results showed that there was no statistical significant difference between both the groups with regard to mean DAS-R anxiety levels at baseline (3.15 and 2.40, respectively, $p=0.07$). However, within Group B the data showed a statistically significant difference between pre- and post-IV treatments ($p<0.01$, 4.33 and 2.13, respectively) and both treatment groups experienced a decrease in anxiety levels from pre to post IV treatments.

Children

Al-Khotani et al 2016 in a RCT evaluated the effectiveness of viewing videotaped cartoons using an eyeglass system (i-theatre™) as an AV distraction technique on behaviour and DA in 56 children receiving dental restorative treatment.[94] Patients were

randomly divided into a control group without distraction (CTR-group) and a distraction-group (AV-group), with each patient provided three dental treatment visits (dental examination, acclimatisation including oral hygiene information and prophylaxis, and restorative visit). Anxiety and cooperative behaviour were measured using the FIS and the Modified Venham's clinical ratings of anxiety and cooperative behaviour scale (MVARS). In addition, physiological measures such as the vital signs, BP and pulse rate were also recorded. Results indicated that the AV-group (0.14 ± 0.36) showed significantly lower mean (SD) MVARS scores compared to the CTR-group (0.75 ± 0.52) (p=0.03), and the scores decreased significantly during treatment in the AV-group (p=0.04). However, there were no statistically significant differences in mean (SD) FIS scores between the AV group (1.93 (1.15)) and CTR-group (1.68 ± 0.86) (p=0.570) but the mean (SD) value of the AV-group was found to be lower after restoration (1.32 ± 0.67) (p=0.057).[94] In addition, there were no significant differences regarding situational anxiety according to the FIS scores between the visits in any of the groups (p=0.34). The pulse rate significantly reduced in the CTR-group during LA injection (p=0.02) compared to the AV-group. The authors concluded that AV distraction using the eyeglass system i-theatre™ was effective in reducing observer-rated DA and eliciting cooperative behaviour in children during restorative dental treatment.[94]

Chaturvedi et al in a RCT evaluated the effectiveness of the AV distraction (AVD) eyeglasses in reducing DA during conventional dental procedures in 40 healthy paediatric dental patients, aged between 6 and 10 years old visiting for the dental treatment with Frankl's behavior rating scale score 3 and 4.[100] Patients were divided into two groups; one group wearing AVD eyeglasses and the other group without wearing AVD eyeglasses. The dental procedures included oral prophylaxis, restorative treatment, and pulpectomy performed during three subsequent visits or more. Anxiety and pain scores were obtained using the WBFPRS, VAS and pulse oximeter. Results revealed that there was statistically significant anxiety and pain reduction (WBFPRS score) in children wearing AV eyeglasses during oral prophylaxis ($p<0.05$), restoration ($p<0.05$), and pulpectomy/root canal treatment ($p<0.005$) when compared to those children who did not wear AV eyeglasses (Table 28).[100] The VAS scores also showed statistically significant anxiety reduction in children wearing AV eyeglasses during oral prophylaxis ($p<0.05$), restoration ($p<0.001$), and pulpectomy/root canal treatment ($p<0.005$) when compared to those without wearing AV eyeglasses. Similarly, statistically significant

anxiety reduction was also seen via pulse oximeter in children wearing AV eyeglasses during restoration ($p<0.01$) but not statistically significant during oral prophylaxis ($p>0.05$) and pulpectomy/ root canal treatment ($p>0.05$) when compared to the children without wearing AV eyeglasses (Table 28).[100]

Table 28 Comparison of WBFPRS and VAS scores and Pulse rate during oral prophylaxis, restoration, pulpectomy/root canal treatment in the intervention and control groups.

	Mean ± SD		
	Intervention group	**Control group**	**P value**
Pain score (WBFPRS)			
Oral prophylaxis	0.35±0.587	1.10±1.021	<0.05
Restoration	1.25±1.070	2.05±1.276	<0.05
Pulpectomy/Root canal treatment	2.20±1.43	3.55±1.23	<0.005
VAS Scores			
Oral prophylaxis	0.40±0.754	1.20±1.322	<0.05
Restoration	1.30±1.380	3.30±2.003	<0.001
Pulpectomy/Root canal treatment	3±1.974	4.95±1.701	<0.005
Pulse rate			
Oral prophylaxis	111.70±18.570	109.05±14.262	>0.05
Restoration	113.35±7.686	117.70±14.546	<0.01
Pulpectomy/Root canal treatment	121.65±8.299	128.25±13.730	>0.05

A study by Kaur et al evaluated and compared audio and AV distraction aids in management of 30 anxious paediatric dental patients of different age groups (4-6 years and 6-8 years).[113] The children of both the age groups were divided into 3 subgroups, the control group, audio distraction group, and AV distraction group, with each child undergoing three dental visits (screening or diagnosis, cavity preparation without the need for LA administration, and LA administration for invasive procedures like tooth extraction or endodontic procedure). The patients in the audio and audiovisual groups listened and viewed to choice based audio (either English or Hindi or Punjabi songs) and AV (either English or Hindi or Punjabi short dramatic clips, video songs and cartoons) presentations through headphones through-out the treatment procedures during all the visits respectively. Anxiety level at each visit was assessed by using a combination of anxiety measuring scales and physiological indices such as dental sub-scale of CFSS-SS, and pulse rate.[113]

Results revealed that the patients in the AV group reported statistically significant reduced anxiety level compared to the audio and control group, whereas those in the audio group reported statistically significant difference only compared to the control

group. AV distraction was found to be a more effective mode of distraction in the management of anxious children in both the age groups when compared to audio distraction. At first visit, there was no statistically significant difference of pulse rate values between the groups before and during the first visit; however, the control group was significantly different (p=0.047) from audiovisual group after the first visit that indicated that the children were most relaxed in AV group in both the age groups.[113]

At the second visit, it was found that both the age groups did not show statistically significant difference of pulse rate values between the groups before the second visit, but during the second visit, the control group was significantly different from AV group in both the age groups. Following the second visit, the control group was significantly different from audio group and statistically highly different from AV group in 4-6 years patients whereas in 6-8 years all the groups were significantly highly different (p=0.000) with each other that indicated that the children were most relaxed in the AV group followed by audio group and were least relaxed in control group.[113] At the third visit in both the age groups, there was no statistically significant difference in pulse rates between the groups before the third visit. During third visit, the AV group was significantly highly different from control group and significantly different from audio group in both the age group. And following the third visit, the control group was statistically significantly highly different (p=0.000) from AV group and significantly different from audio group (p=0.013).[113]

Nuvvula et al determined the effect of three-dimensional (3D) AV distraction in reducing DA of 90 children (aged between 7 and 10 years) during LA administration.[121] Ninety children were randomly divided into three groups; control (basic behaviour guidance techniques without distraction), audio (basic techniques plus music) and AV (basic techniques plus 3D AV) distraction groups. Anxiety was assessed using a combination of measures: MCDAS(f), PR, behaviour (using Wright's modification of Frankl behaviour rating scale and Houpt scale) and preferences of children. A highly significant reduction in the anxiety of AV group as reported by the MCDAS(f) values ($p < 0.001$) and Houpt scale ($p = 0.003$); whereas PR showed statistically significant increase ($p < 0.001$) in all the three groups irrespective of distraction as seen in Tables 29 & 30. The child preferences also affirmed the usage of 3D video glasses. Local analgesic administration with music or 3D video glasses distraction had an added advantage in

most children with 3D video glasses being superior to music. High levels of satisfaction from children who experienced treatment with 3D video glasses were also observed.[121]

Table 29 MCDAS (f) scores before and after local analgesia administration

Group (N = 30 in each)	Before treatment procedure (mean ± SD)	After local analgesia administration (mean ± SD)	p value (before vs. after)
I	20.6 ± 2.4 (95 % CI 19.7–21.5)	20.9 ± 7.2 (95 % CI 18.2–23.5)	0.83 NS
II	21.5 ± 2.5 (95 % CI 20.6–22.4)	14.1 ± 4.4 (95 % CI 12.4–15.7)	0.001
III	22.2 ± 4.0 (95 % CI 20.7–23.7)	8.3 ± 2.5 (95 % CI 7.3–9.2)	0.001
Intergroup comparisons	**Before treatment procedure (p value)**	**After local analgesia administration (p value)**	
Group I vs. II	0.77NS	0.001	
Group II vs. III	1.0NS	0.001	
Group I vs. III	0.14NS	0.001	

Table 30 Pulse rates before and during local analgesia administration

Group (N = 30 in each)	Before treatment procedure Mean ± SD	During local analgesia administration Mean ± SD	p value (before vs. during)
I	95.4 ± 5.6 (95 % CI 93.3–97.5)	119.0 ± 13.1 (95 % CI 114.1–123.9)	0.001***
II	89.3 ± 3.3 (95 % CI 88.1–90.6)	104.6 ± 2.9 (95 % CI 103.5–105.6)	0.001***
III	102.4 ± 8.1 (95 % CI 99.4–105.5)	109.4 ± 5.0 (95 % CI 107.5–111.2)	0.001***

Attar & Baghdadi conducted a study to compare the effects of two types of AV distraction techniques: passive, using AV glasses, versus active, using an iPad, as an adjunct to LA during vital pulp therapy in children.[99] Pain behaviour, and heart rates were compared in children aged between 4–8 years who received the two treatment sessions. The Modified Dental Anxiety Scale was used to assess patients' anxiety pre-operatively, as perceived by children's parents and The Wong-Baker FACES Pain Rating Scale (FACES) was used to measure pain by asking a child to choose the face that best described how they felt at each treatment interval. The mean and SD scores for the MDAS were 9.87 (SD 3.50; 95 % CI 2.7–4.13) for all child patients, 9.45 (3.69) for males, and 10.32 (3.33) for females which was not statistically significant (p 0.44). Generally, AV glasses had higher pain and behaviour scores than iPad. Average heart rates over the treatment intervals were lower among children when using iPad than when using AV eyeglasses. The differences between heart rate at baseline for each session and heart rate at each treatment interval were calculated for both distraction techniques. This

difference, was significant during RD placement (p 0.024) and LA administration (p 0.001). Average heart rates over the treatment intervals were lower among iPad group than those using AV glasses group. Patients preferred an iPad more than AV glasses (24 versus 15).[99]

Mitrakul et al in a split-mouth crossover RCT evaluated the effect of AV eyeglasses on pain and anxiety levels during restorative treatment in 42, 5-8 year-old Thai children with bilateral carious molars.[117] Group I received treatment without wearing AV eyeglasses in the first visit and wearing the eyeglasses in a second visit and Group II was vice versa, with treatments performed in two visits, 1 to 4 weeks apart. The Faces Pain Scale-Revised (FPS-R), face, legs, activity, crying and consolability scale (FLACC) and HR were measured to measure pain and anxiety levels pre-operatively, during rubber dam placement, during the first use of high speed hand piece, and at five minutes interval during the remaining treatment. The results showed that the mean pain scores in group I were 1.62±2.94 and 0.86±1.49 when not wearing AV eyeglasses in the first visit and wearing the eyeglasses in a second visit, respectively. The mean pain scores in group II were 1.9±2.93 and 1.9±3.32 when wearing AV eyeglasses in the first visit and not wearing the eyeglasses in a second visit, respectively. The HR between the two groups in both visits during restorative dental treatment is shown in Table 31.[117]

Table 31 Heart rate between two groups in both visits during restorative dental treatment

Treatment step	Group	Heart rate (Mean±SD)		Intergroup p-value	
		Visit 1	Visit 2	Eyeglasses effect	Carry-over effect
Pre-operation	I	94.57+15.09	88.14+10.07	0.043	0.484
	II	88.06 +12.74	89.86+12.11		
Rubber dam placement	I	101.86+15.24	95.38+11.56	0.002	0.898
	II	100.86+13.97	95.38+14.68		
First use of high speed hand piece	I	101.43+12.86	97.76+12.26	0.049	0.577
	II	99.57+14.85	95.52+13.09		
During the remaining treatment	I	96.96+11.90	93.15+9.81	0.035	0.633
	II	95.24+12.11	91.96+10.50		

Aminabadi et al evaluated the influence of using virtual reality (VR) eyeglasses on severity of pain and anxiety during dental procedures in 120 paediatric patients, aged 4-6 years who were randomly divided into two groups (one with VR and another without VR).[97] The study consisted of 3 consecutive treatment sessions. At the end of each session the subjects' pain severity was assessed using WBFPRS and state anxiety was

measured by MCDAS (f). The results suggested that there was a significant decrease in pain perception ($P < 0.001$) and state anxiety scores ($P < 0.001$) with the use of virtual reality eyeglasses during dental treatment. The Mean MCDAS (f) anxiety scores in the first (with VR distraction) and second (without VR distraction) treatment sessions were 12.58 ± 1.01 and 17.68 ± 1.25, respectively.

Sullivan et al investigated the effect of virtual reality on the behaviour and anxiety of children during dental treatment in 26 children, aged between 5 to 7 years.[125] Thirteen children viewed virtual reality at their first restorative visit and not the second, and thirteen children viewed virtual reality at the second restorative visit and not the first. The restorative appointments were video recorded and heart rate monitored. The drawings and videotapes were rated independently by two examiners. The Koppitz method of evaluating drawings was used to measure anxiety. The Frankl behaviour rating scale was used to evaluate behaviour. Differences in behaviour ($p \leq 0.50$) and anxiety ($p \leq 0.65$) were not significant. The Frankl rating for the two appointments combined was 0.30, S.D. = 1.29 with virtual reality and 0.59, S.D. = 1.17 without virtual reality. The overall PR was significantly lower ($p \leq 0.001$) when the child was wearing glasses and viewing virtual reality. During the administration of the LA, the elevation of the pulse in the virtual reality group was significantly less than in the non-virtual reality group.[125]

Asvanund et al conducted a crossover trial that evaluated the effectiveness of AV eyeglasses on pain reduction during LA injection in 49 children, aged 5 to 8 years old. Subjects were randomly divided into two groups according to the sequence of AV eyeglasses used.[98] Group I received the injection without wearing AV eyeglasses in the first visit and then wearing AV eyeglasses in a second visit. In Group II it was vice versa. Self-reporting pain using the Faces Pain Scale-Revised (FPS-R), face, legs, activity, crying, and consolability scale (FLACC), and heart rate (HR), were measured to assess the injection pain. Pain scores were lower when the patients had their injection while wearing AV eyeglasses in both groups. No subject reported a maximum score on the pain rating scale when wearing AV eyeglasses, while 14% of the subjects reported so when not wearing the eyeglasses. AV eyeglasses significantly reduced FLACC scores ($p = 0.03$) and HR ($p = 0.005$) when compared with not wearing the eyeglasses ($p = 0.05$).[98]

Fakhruddin et al[105] conducted a crossover RCT to assess the effectiveness of AV distraction technique with video eyewear and computerised delivery system-intrasulcular (CDS-IS) during the application of LA in 60 dentally phobic paediatric patients (aged between 4 and 7 years) who underwent pulp therapy of primary molars over two treatment sessions, 1-week apart. Patients were randomly allocated to group A and group B. During treatment session I, group A had an AV distraction with video eyewear, whereas group B had AV distraction using projector display only, without video eyewear. During treatment session II, it was vice versa. The MCDAS (f) was used to evaluate the level of anxiety before treatment and the Wong Bakers' faces pain scale for self-rating of pain. In addition, changes in pulse oximeter and heart rate were recorded in every 10 min (Table 32). The results indicated that there was a significant ($p>0.03$) change in the mean anxiety score in group A from preoperative treatment session I to preoperative treatment session II. Self-reported mean pain score also decreased significantly after treatment sessions' with video eyewear in both the groups.

Table 32 Mean changes in pulse oximetry and heart rate

	Change in pulse oximetry	**Change in heart rate**
Treatment session I		
AV distractor without video eyewear during dental prophylaxis	3.02 ± 1.51	5.61 ± 1.03
AV distractor with video eyewear during dental prophylaxis	2.15 ± 1.02	2.53 ± 1.24
AV distractor with video eyewear during dental impression	2.18 ± 1.04	3.04 ± 1.12
P value	0.42	0.03
Treatment session II		
AV distractor with video eyewear during dental anaesthesia using CDS-IS system	3.05 ± 1.03	3.65 ± 1.03
AV distractor with video eyewear during tooth preparation for stainless steel crown	3.12 ± 1.16	5.83 ± 2.02
P value	0.61	0.53
Treatment session III		
AV distractor with video eyewear during dental anaesthesia using CDS-IS system	1.71 ± 1.01	2.82 ± 0.47
AV distractor with video eyewear during tooth preparation for stainless steel crown	2.87 ± 0.68	4.68 ± 0.96
P value	0.43	0.09

Values in Mean ± SD

Frere et al investigated the effects of a virtual image A/V eyeglass system on anxiety and pain in 27 routine dental prophylaxis patients who participated and completed the DFS and the Fear of Pain Questionnaire-III before treatment.[107] The clinician in a random order scaled and polished two quadrants in subjects while they watched and listened to a standard video using the A/V eyeglasses and two quadrants while they did not. A posttreatment questionnaire was administered to both the patient and the clinician. Participants reported less anxiety and discomfort when using the A/V eyeglass system than when they did not and most them preferred to use the A/V equipment rather than receive traditional treatment (Table 33). The system appeared to lead to some decreases in the physiological parameters over the course of treatment, with the highest systolic blood pressure occurring after the condition with no use of A/V eyeglasses.[107]

Table 33 Dental anxiety and pain – use of AV eyeglasses vs non-use of AV glasses

Variable	Mean	Standard Deviation	P value
Anxiety level during treatment	2.7	1.0	0.001
Discomfort (Pain)	2.5	1.1	0.001
Preference	5.2	1.8	0.003
Video enjoyable	4.8	1.5	0.001

Pictorial/s

Aminabadi et al conducted a triple-blinded RCT in Iran that evaluated the effect of listening to a pictorial story about going to the dentist on pain perception, situational anxiety and behavioural feedback during dental treatment in eighty 6-7-year-old paediatric dental patients.[96] The childhood anxiety-related disorders using Screen for Child Anxiety Related Disorders (SCARED) Parent Version scale were evaluated. The patients were randomly assigned to two groups, listening to a pictorial story about going to a dentist (intervention), or listening to a pictorial story about going to a barbershop (control). Pain perception and situational anxiety were assessed using WBFPRS and $MCDAS_f$, respectively (Table 34). There was a significant decrease in pain perception ($P=0.02$) and situational anxiety ($P<0.001$) in the intervention group.

Table 34 Mean and SD of study variables based on groups

Group	N	Mean	SD
SCARED score			
Intervention	40	17.00	0.282
Control	40	17.03	0.274
Pain score			
Intervention	40	1.00	0.129
Control	40	1.48	0.152
MCDAS score			
Intervention	40	16.00	0.297
Control	40	25.35	0.476

Imagery

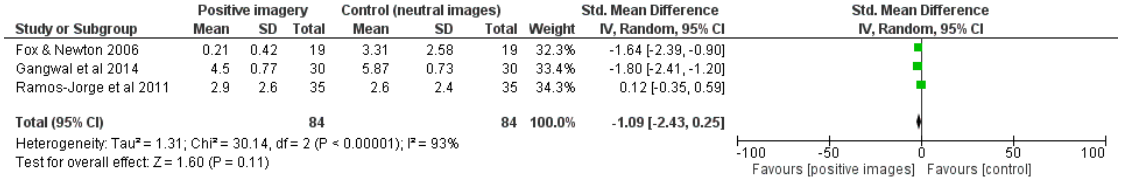
Three studies that were sufficiently similar were included in a meta-analysis (Figure 11) that reported on DA reduction following viewing of positive images but before the dental procedure was undertaken.[106, 108, 123] Overall, the findings showed that there was a difference in anxiety scores measured using Venham Picture Test (VPT) between the intervention (viewed positive dental images) and the control group (viewed neutral dental images), which was not that significant. Fox & Newton conducted a RCT to determine the impact of viewing positive images of dentistry prior to a dental appointment on the anticipatory DA levels of 38 children attending for dental treatment in South West England.[106] The intervention consisted of viewing positive images of dentistry and dental treatment, the control condition consisted of dentally neutral images, for 2 min in the waiting area prior to their appointment A significant difference in anticipatory DA was found between the two groups (median-positive images = 0, median-neutral images = 3; $P < 0.001$). The mean and SD in the intervention group was 0.21 (0.42) compared to 3.31 (2.58) in the control group. Viewing positive images of dentistry and dentists resulted in short-term reductions in anticipatory anxiety in children.

Similarly, in another study, Gangwal et al evaluated the effect of exposure to positive images of dentistry on DA among 60 children, aged between 7 to 12 years.[108] The intervention consisted of viewing positive images of dentistry and dental treatment (intervention group), the (control group) consisted of neutral images for 2 min in the waiting area prior to their appointment. The mean anxiety score found at waiting area before intervention, after intervention (OPD) and postoperative was statistically significant in the intervention group. Post hoc comparison of anxiety score in the intervention group showed high statistical significance. The mean anxiety score found at

waiting area, after intervention (OPD) and post-operative was 6.10 ± 0.80, 4.50 ± 0.77 and 3.70 ± 0.70 respectively and the difference between these values was highly statistically significant (p value = 0.00).[108]

Ramos-Jorge et al determined whether exposing children to images of positive dental care would influence their degree of anxiety, assessing anxiety three separate times in a RCT that included 70 participants between 4-11 years of age.[123] The intervention consisted of viewing positive images of dentistry and dental treatment. The control condition consisted of dentally neutral images. Anxiety was assessed using the VPT prior to the intervention, immediately following the intervention and following the dental appointment. No significant difference was detected between the scores of the VPT in the two groups at any evaluation time (before intervention 3.2 ± 2.8 & 2.7 ± 2.4, p=0.692; after intervention 2.9 ± 2.6 & 2.6 ± 2.4, p = 0.871; and after dental appointment/exam 2.4 ± 2.7 & 2.3 ± 2.4, p=0.660) respectively. Viewing positive images of dentistry and dentists did not have a greater effect on child anxiety in the dental setting than viewing neutral images; however, showed lower rates of anxiety for all children although this was not significant. However, when considering the overall sample, a significant reduction in DA scores was found before (3.1 ± 2.7) and after (2.5 ± 2.6) the intervention (p=0.009) and before (3.1 ± 2.7) the intervention and following the dental appointment (2.3 ± 2.7) (p = 0.014).[123]

Figure 11. Dental anxiety reduction – Positive imagery vs Control (neutral dental images)



Wade conducted a RCT that examined the effectiveness of relaxation imagery in reducing DA in 60 patients receiving dental treatment.[127] Patients were randomly divided into three groups with the control group receiving only progressive muscle relaxation and the other two groups receiving either directed or self-generated imagery. The results showed that patients in the all the three groups a highly significant decrease in DA following relaxation treatments. In addition, both imagery treatments were found to be superior to progressive muscle relaxation; however, this was not statistically significant. Self-generated imagery was more effective in reducing DA in patients who highly preferred autonomy and directed imagery was more effective in those who had

low preference of autonomy. The percentage decrease in DA in the control group was 37.3% compared to 45% and 52.5% in the directed imagery group and self-generated imagery group respectively.[127]

Video (Cartoon film)

Jimeno et al in a non-randomised crossover trial evaluated whether the parental perception of the patient's anxiety, children's anxiety, pain, behaviour and HR of 34 paediatric patients (aged 6-8 years) improved when an AV technique was used.[111] The results showed that there was a significant improvement in the global behaviour when children were shown a cartoon film ($P < 0.001$). A significant increase in heart rate was recorded in both visits ($P = 0.0001$) when the anaesthetic was injected. A 97% of the sample would like to continue seeing their chosen film during subsequent visits. No statistically significant differences were found ($P > 0.05$) between the visits in terms of parental perception of the patient's anxiety, or the patient's self-reported anxiety, pain and heart rate (Table 35).[111]

Table 35 Mean and SD for variables measured

Variable	Control	Intervention	P value
MCDAS	9.29 ± 3.39	8.55 ± 3.32	0.07 NS
VPT	0.47 ± 1.46	0.17 ± 0.75	0.30 NS
WBFS	1.41 ± 2.17	1.35 ± 2.29	0.90 NS
Frankl behaviour rating scale	2.79 ± 1.12	3.41± 0.85	0.001*
Heart rate	103.22 ± 14.92	100.92 ± 13.37	0.24 NS

Multimedia

Srai et al conducted a RCT to assess whether provision of additional multimedia information regarding the bond-up procedure affected anxiety in adolescent orthodontic patients, aged between 10 to 16 years of age.[124] Both groups were given verbal information regarding the bond-up procedure, and the intervention group was additionally given a DVD showing a bond-up. Anxiety was assessed using the STAI for Children, with state anxiety as the primary outcome measure. A statistically significant difference was found between groups, with a difference in scores of 2 (95% confidence interval for the difference = 0.15 to 3.85). The median state anxiety was 32 in the control group ($n = 42$) and 30 in the intervention group ($n = 43$; $P = 0.012$). Additional

information reduced anxiety levels, but other methods could be more cost-effective than the DVD.[124]

Choi et al[101] in a RCT examined the effectiveness of an AV slide presentation (that provided treatment information regarding the removal of an impacted mandibular third molar) in reducing DA in young adults before and after surgery compared to those who received conventional written description of the procedure. The trial included 51 patients, aged between 18 to 27 years. Outcome measurements included STAI, DAS, and a self-reported anxiety questionnaire. On conclusion of the trial, it was found that the AV informed group had reported lower self-reported anxiety scores compared to the control group 1 week after surgery ($p<0.05$). However, there were no differences between the two groups in regards to the STAIS, STAI-T, or DAS scores before and after surgery (Table 36).

Table 36 Means and standard deviations of the anxiety parameters for the 2 groups

Variable	Written informed group	AV informed group	P value
STAI-S score			
Immediately before surgery	43.3 ± 8.5	42.5 ± 9.4	0.754
1 week after surgery	31.1 ± 5.8	29.2 ± 7.4	0.344
STAI-T score			
Immediately before surgery	39.1 ± 6.4	37.2 ± 7.6	0.404
1 week after surgery	33.2 ± 7.2	32.3 ± 6.5	0.406
DAS score			
Immediately before surgery	10.8 ± 2.9	10.7 ± 2.3	0.948
1 week after surgery	9.0 ± 3.0	8.0 ± 2.4	0.421
Self-reported anxiety score			
Immediately before surgery	4.3 ± 2.9	3.9 ± 2.6	0.665
1 week after surgery	2.5 ± 1.8	0.7 ± 1.2	<0.05

Results presented as mean ± SD

In a quasi-experimental study, Moura et al[119] assessed emotional reactions in 20 children (aged 4-6 years) before and after the application of a child AV book illustrating the trigger fear and anxiety points in the dental appointment. The FIS was used to assess the outcome before the child came into contact with the book in the dental clinic room and after the child came into contact with the playful instrument. Results showed that there were no differences in childhood anxiety between genders and ages. There was a

significant decrease in anxiety as a result of applying the book as a playful tool for psychological conditioning.

Table 37 Assessment of methodological quality (AV)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Abhishek 2016	Quasi-experimental	N	N	N	N	N	Y	Y	Y	N	U	E	3
Affeldt-Devine 2006	Pseudo RCT	Y	N	N	N	N	U	Y	Y	Y	Y	I	5
Aitken et al 2002	Quasi-experimental	N	N	N	N/A	Y	Y	Y	Y	Y	Y	I	6
Al-Khotani et al 2016	RCT	Y	N	N	N/A	Y	Y	Y	Y	Y	Y	I	8
Aminabadi et al 2011	RCT	Y	Y	Y	N/A	Y	Y	Y	Y	Y	Y	I	9
Aminabadi et al 2012	RCT	Y	Y	Y	N	N	Y	Y	Y	Y	Y	I	8
Asvanund et al 2015	Split mouth RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Attar & Baghdadi 2015	Split mouth RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Bird 1997	Case report	N	U	N	N	N	N	N	N	Y	N	E	1
Chaturvedi et al 2016	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Choi et al 2015	RCT	U	N	N	N/A	N	Y	Y	Y	Y	Y	I	5
Cipolloni 2012	Quasi-experimental	N	N	N	N/A	N	Y	Y	Y	Y	Y	I	5
DeNitto 2012	RCT	Y	N	N	N	Y	Y	Y	Y	Y	Y	I	7
Diaz-Orueta et al 2012	Quasi-experimental	N	N	N	N	N	U	Y	U	U	U	E	1
Di Nasso et al 2016	RCT	U	Y	U	N	U	Y	Y	Y	Y	Y	I	6
Fakhruddin et al 2015	Crossover RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Florella et al 2010	Case report	N	U	N	N	N	N	N	U	U	N	E	0
Fox & Newton 2006	RCT	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	I	10
Frere et al 2001	RCT	Y	N	N	N	N	U	Y	Y	Y	Y	I	5
Gangwal et al 2014	RCT	Y	Y	N	N/A	Y	U	Y	Y	Y	Y	I	7
Goff 1997	RCT	Y	N	N	N	N	Y	Y	Y	N	Y	I	5

Green 1952	Quasi-experimental	N	N	N	N	N	U	U	Y	N	N	E	1
Horan et al 1976	RCT	U	N	N	N	N	U	Y	U	U	N	E	1
Ingersoll et al 1984	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Jimeno et al 2014	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Jindal et al 2011	Quasi-experimental	N	N	N	N/A	N	Y	Y	Y	Y	Y	I	5
Kaur et al 2015	RCT	U	N	N	N	Y	Y	Y	Y	Y	Y	I	6
Jembulingam et al 2016	Cross-sectional	N	Y	N	Y	Y	N	N	N	Y		I	5
Kyoung Kim 2011	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Lai et al 2008	Block RCT	Y	N	N	N/A	N	Y	Y	Y	Y	Y	I	6
Manan et al 2017	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	N	E	4
Marwah et al 2005	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Mejía-Rubalcava et al 2016	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Mitrakul et al 2015	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Miyata et al 2016	RCT	Y	N	Y	N	N	Y	Y	Y	Y	Y	I	7
Moura et al 2015	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Naithani & Viswanath 2014	RCT	U	N	N	N	N	U	Y	Y	Y	N	E	3
Navit et al 2015	RCT	Y	N	N	N	N	U	Y	Y	Y	Y	I	5
Nuvvula et al 2015	RCT	Y	N	Y	N/A	N	Y	Y	Y	Y	Y	I	7
Olszewska & Zarow 2003	Quasi-experimental	N	N	N	N	N	Y	U	U	Y	Y	E	3
Padrino-Barrios 2013	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	6
Parkin 1981	RCT	Y	N	N	N	Y	U	Y	Y	U	U	I	4

Prabhakar et al 2007	Quasi-experimental	N	N	N	N	N	U	Y	Y	Y	U	E	3
Ramos-Jorge et al 2011	RCT	Y	Y	Y	N/A	Y	Y	Y	Y	Y	Y	I	9
Satoh et al 1995	Quasi-experimental	N	N	N	N	N	U	U	Y	Y	U	E	2
Sardari & Mashizi 2016	RCT	U	N	N	N	N	Y	Y	Y	U	Y	E	4
Singh et al 2014	RCT	U	N	N	N	N	U	U	Y	Y	Y	E	3
Srai et al 2013	RCT	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	I	9
Sullivan et al 2000	Quasi-experimental	N	N	N	N	N	U	Y	Y	Y	Y	I	4
Thoma et al 2015	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Wade 1991	RCT	Y	N	N	N	N	U	Y	Y	Y	Y	I	5
Weinstein et al 2003	Quasi-experimental	N	N	N	N	N	U	U	Y	Y	Y	E	3
Wiederhold et al 2014	Quasi-experimental	N	N	N	N	N	U	Y	Y	U	U	E	2
Yamini et al 2010	RCT	U	N	N	N	N	U	Y	Y	Y	U	E	3

4.4.4. Behaviour therapy

Fifty-six studies (18 RCTs, 15 quasi-experimental studies, 17 cross-sectional survey studies, three expert opinion articles, two case reports and one cohort study) were included in the review that examined behaviour therapy interventions.[10, 17, 55, 128-181] Several survey studies reported on the use of behaviour management techniques (BMTs) by dentists and the acceptability and the attitudes of the patients and parents of the patients towards these techniques. This section has been further divided into two subsections, one examining the effectiveness and the other the acceptability of behavioural interventions or behaviour management techniques (BMTs).

Effectiveness

Adults

Aartman et al assessed differences among highly anxious dental patients (n=211) who were exposed to different treatment modes that included behavioural management, nitrous oxide sedation, and intravenous sedation.[128] Results indicated that of the 144 patients who received dental treatment at the clinic, 46.5% of the patients were treated using a behavioural management approach, 27.8% with nitrous oxide sedation, 22.9% with intravenous sedation, and 2.8% under GA. There were no significant differences among the treatment groups on dental anxiety. Aartman et al conducted another trial to assess the effect of behavioural management on dental anxiety reduction at a post-treatment assessment and one year later in comparison with nitrous oxide sedation, and intravenous sedation at a dental fear clinic in The Netherlands.[129] Dental anxiety before (T1) and after (T2) treatment and one year later (T3) was assessed using the Dental Anxiety Scale (DAS) and the Short version of the Dental Anxiety Inventory (S-DAI). Results showed that the DAS and S-DAI scores at T2 and T3 were statistically significantly lower than the initial scores.

In a quasi-experimental study involving 128 adult patients attending a dental hospital rated vignettes describing the management of an adult who was severely dentally anxious.[134] The 8 vignettes included: treatment urgency (presence or absence of pain),

method of intervention (psychological approach versus use of sedation) and treatment outcome (good outcome - individual overcame dental anxiety to attend regularly, or poor outcome - individual did not attend following the treatment). Overall the results indicated the psychological intervention was rated as more acceptable than the use of sedation ($F = 7.60$, $p < 0.01$), and interventions which resulted in good outcomes were rated as more acceptable ($F = 148.8$, $p < 0.001$). It was found that acceptability was strongly influenced by the outcome of the treatment not considering the urgency of the treatment.

Baker in 1982 investigated the use of Visual Kinaesthetic Dissociation (VK-D) to reduce dental anxiety in patients undergoing outpatient oral surgery.[136] The 30 patients who had high DA were randomly assigned to the VK-D group or to an informational slide show (ISS) group. Statistical analyses revealed that the VK-D significantly reduced dental anxiety when compared to the ISS and this reduction of dental anxiety in the VK-D group was sustained for even two weeks after the treatment.

Berggren & Linde conducted a study to compare behavioral therapy from a psychologist with GA in 90 patients, who had avoided dental treatment for longer periods due to severe dental fear.[139] A significant number (92%) of patients in the behavioural therapy group completed the treatment program when compared to those in the GA group (69%). There was a significant reduction in DA as measured by the Corah's DAS in both groups; but it was significantly more in patients in the behavioural therapy group. In addition, it was reported that patients' self-reported tension and the dentists' ratings of patient behaviour during treatment were significantly more positive for the behaviour therapy group. Berggren & Carlsson in 1986 conducted a clinical trial involving 99 severely phobic individuals who were assigned to either GA or a broad-based psychophysiological therapy.[138] Similar to the study by Berggren & Linde (1984),[139] the results in this study[138] indicated a significantly better effect for the psychophysiological therapy. A follow-up study was conducted by Berggren for more than two years from 84 out of 99 patients treated for dental fear in a Swedish community-based dental fear clinic using either broad-based behavioral therapy or GA.[137] Results indicated the more number of patients who underwent behaviour therapy attended a dental clinic later and that most patients had no problems after leaving the dental fear

clinic. The level of dental anxiety as measured by Corah's DAS was still at a low level, despite a slight increase over the two years since initial therapy.

Carpenter et al evaluated the effectiveness of a videotaped behavioural treatment program in reducing DA where they compared patients, aged >18 years (n=66) who witnessed a 30-minute intervention videotape with patients who saw a 30-minuteplacebo program and with a no-treatment control group.[141] Results indicated that there was a significant gender interaction effect during the different assessment periods, with men responding best to the treatment videotape, whereas women responded best to the placebo videotape.

Corah et al (1981) in a RCT including 80 dental patients (aged from 17-38 years) who required two amalgam dental restorations randomly assigned them to four groups: a control group in which the restorations were completed in the typical fashion; a group who listened to standard relaxation instructions during the dental procedure; a group who listened to relaxation instructions presented in a conversational tone and pace; and a group who listened to a travelogue presented in a calm, quiet voice at a slow pace.[10] Results indicated that content may be somewhat more important than style in relaxation instructions. The mean differences in terms of discomfort between first and second visits: control group (0.90), standard relaxation group (1.30), relaxation content group (0.80), and story style group (0.50).

Gatchel in 1986 assessed the impact of a videotaped dental fear-reduction program in people (aged >21 years) with moderate and high dental fear and who avoid dental treatment for longer periods.[149] Patients in this study were assigned to either a videotaped treatment group or a videotaped placebo group. The results indicated that there was a significant reduction in self-reported fear in the videotaped treatment group produced; however, it was reported that the intervention program increased dental visitation and appointment-making behaviour only for moderately fearful subjects.

Gitin in her thesis that evaluated the efficacy of a one-session exposure based treatment (based on Lars-Goran Ost model consisting of in vivo exposure and therapist modelling) for odontophobia, as an alternative to the more elaborate methods of treatment in 22 patients (aged from 16 to 65 years).[151] The intervention resulted in a significant decrease

in DA from pre-to post-treatment. In addition, there was a significant decrease in mean pulse rate from initial presentation of stimulus to the post-exposure, following treatment.

Jerremalm et al investigated whether matching of treatment techniques and individual response patterns yielded better treatment results than using a treatment technique not matched to the patients' response patterns in 37 patients (aged between 21-66 years) with dental phobia.[153] Patients were randomly assigned to either a cognitively focussed method (self-instructional training, SIT) or a physiologically focused method (applied relaxation, AR) and they were treated in groups of 4 or 9 sessions. Results in terms of within-group comparisons showed that both treatments yielded significant improvements on all outcome measures but between-group comparisons did not show any significant differences. The results on the self-report measures are summarised in Table 38. The results are somewhat varied. On the DFS, cognitive reactors changed significantly both with AR and SIT. Physiological reactors did not change in a significant way on the DFS. The DAS changed significantly for cognitive reactors receiving SIT; and for physiological reactors both with AR and SIT. There were no significant between-groups differences on any measure.[153]

Table 8 Cognitive and physiological reactors for two modes of treatment

Measure	**Cognitive reactors**		**Physiological reactors**	
	AR	**SIT**	**AR**	**SIT**
DFS				
Pre	17.9 (15.6)	86.9 (4.3)	71.6 (17.8)	91.4(12.2)
Post	55.5 (19.2)	65.6 (19.8)	68.6(19.1)	73.1 (23.3)
t	2.21*	3.01*	0.49	1.83
DAS				
Pre	16.1 (2.4)	17.1 (2.9)	14.4(1.7)	17.1 (3.3)
Post	12.5 (3.8)	10.7 (3.5)	12.3 (2.7)	12.4 (4.5)
t	1.82	5.41***	3.04*	2.91*

*P < 0.05; **P < 0.01; ***p < 0.001

Kvale et al in a quasi-experimental study evaluated treatment effects in 70 patients in a specialised university clinic for treatment of dental fear.[17] Forty seven percent of the patients fulfilled the diagnostic criteria for Specific Phobia alone (Dental Phobia, DP), 33% had severe DA without fulfilling the criteria for phobia (ND), and 19% fulfilled the criteria for multiple DSM-IV diagnoses (MD). Dental attendance and everyday functioning were measured by self-report. The treatment consisted of exposure to specific individualised components of the dental treatment. Results showed that there was a significant reduction in DAS-scores from pre to post treatment, and to follow up ($F(2, 72)=77.5$, $p<0.001$) (Table 39) and also a significant group difference (F(2,

36)=4.05, p<0.03) in reported DA as measured by DAS. Further, there was a significant reduction in DFS scores from pre to post treatment and follow up (F(2, 70)=56.8 p<0.001). It was found that the patients in the MD group had significantly higher scores as compared to the ND group. In terms of DBS score, there was a significant reduction from pre to post-treatment and follow up (F(2, 66)=33.6, p<0.001).[17]

Table 39 Mean scores and (Standard Deviations) on DAS, DFS and DBS at pre- and post-treatment, and at one year follow-up. Norwegian norms are given in the right column

	All N=70 (100%)	**No diagnosis N=24 (33%)**	**Dental phobia N=33 (47%)**	**Multiple diagnoses N=13 (19%)**	**Norwegian norms**
DAS					
Pretreatment (N=70)	16.4 (1.3)	15.0 (3.6)	17.1 (2.8)	17.1 (2.3)	
Post treatment (N=46)	8.1 (2.5)	7.7 (2.0)	8.0 (2.6)	9.1 (1.3)	
Follow up (N=57)	10.6 (4.0)	9.2 (3.4)	11.3 (3.4)	12.6 (3.8)	8.1 (3.6)
DFS					
Pretreatment (N=70)	78.3 (1.13)	72.1 (2.16)	81.4 (6.9)	82.4 (9.10)	
Post treatment (N=46)	44.3 (15.0)	42.4 (9.12)	44.0 (9.14)	49.5 (9.19)	
Follow up (N=56)	57.5 (7.19)	49.7 (7.20)	58.1 (19.0)	68.9 (5.14)	44.6 (6.19)
DBS					
Pretreatment (N=69)	46.0 (1.11)	45.6 (7.10)	46.8 (6.11)	44.7 (2.11)	
Post treatment (N=45)	23.0 (4.12)	23.6 (2.12)	22.7 (3.12)	22.3 (6.14)	
Follow up (N=56)	33.6 (5.14)	29.6 (7.12)	34.6 (6.14)	37.8 (4.16)	25.2 (7.9)

Liddell et al in a quasi-experimental study examined the long-term effects of behavioural treatment programs in 26 dentally anxious subjects (aged from 20 to 56 years) who had successfully completed a 4-session behavioural group programme.[159] The CDAS scores of regular and irregular attenders were compared over time using repeated measurement method and it was found that there was a significant overall decrease in DA over time [F(J.I8) = 62.01, p< 0.001]; however, the overall decrease in DA was significantly less in the irregular attenders compared to the regular attenders [F(3,18) = 5.16, p<0.01].

Litt et al conducted two studies in which dental patients (mean age of 23 years) were assigned to receive 1 of 5 anxiety reduction interventions to prepare them for third molar tooth extraction and these interventions included standard clinic treatment, oral premedication, and several relaxation-based procedures.[160] Overall, the study results

showed that interventions, particularly those including relaxation therapies were significantly effective in reducing DA prior to oral surgery.

Moore et al in a RCT examined the effects of extreme dental fear treatment on general anxiety and mood in 60 dental phobics (aged from 19 to 65 years) with high and low general anxiety who were compared 75 dental phobics on a waiting list.[166] The treatment involved progressive muscle relaxation training and exposure to eight 30 second videotaped scenes of routine dental procedures. In addition, the treatment included systematic desensitisation technique and clinical rehearsals involving direct exposure to threatening dental situations or dental instruments in gradual approximating steps. Results showed that there were significant reductions in dental fear and patients reported less fear of going to the next dentist after the program. Outcome measure scores on DFS and STAI-S showed significant dental fear reduction for each of the experimental methods ($p<.001$) as seen in Table 40.[166]

Table 40 Summary Statistics for Dental Fear and Trust Scales and VAS for Treatment and Control Groups (Mean and SD scores)

Test	Treated group (N=60)	Video training group (N=27)	Rehearsal group (N=33)	Control group (N=75)
Dental Anxiety Scale (20 pt max)				
Pretest (T1)	18.0 ± 1.4	18.0 ± 1.6	17.9 ± 1.2	17.0 ± 2.7
Posttest (T2)	9.5 ± 2.5	9.2 ± 2.6	9.8 ± 2.4	16.7 ± 2.9
Postdental T_X (T3)	7.7 ± 2.6	7.2 ± 2.3	8.1 ± 2.7	* *
Dental Fear Survey (100 pt max)				
Pretest (T1)	74.4 ± 13.1	76.0 ± 12.8	73.0 ± 13.3	* *
Posttest (T2)	38.6 ± 11.5	39.5 ± 12.8	37.8 ± 10.5	* *
Postdental T_X (T3)	31.8 ± 7.8	30.1 ± 7.2	33.3 ± 8.1	* *
STAI-State (80 pt max)				
Pretest (T1)	69.9 ± 7.1	70.4 ± 4.9	69.5 ± 8.5	68.4 ± 10.1
Posttest (T2)	37.4 ± 10.6	33.4 ± 10.5	40.7 ± 9.6	69.0 ± 9.5
Postdental T_X (T3)	32.7 ± 9.3	30.3 ± 8.4	34.6 ± 9.7	* *
Dental Beliefs Survey (75 pt max)				
Pretest (T1)	48.3 ± 11.7	46.8 ± 13.8	49.6 ± 9.9	* *
Posttest (T2)	19.3 ± 6.9	20.0 ± 9.4	18.8 ± 3.9	* *
Postdental T_X (T3)	17.5 ± 3.9	16.8 ± 3.8	18.0 ± 3.9	* *
VAS				
Pretest (T1)	87.8 ± 10.6	87.0 ± 12.7	88.5 ± 8.7	* *
Postdental (T3)	15.0 ± 13.3	14.8 ± 12.8	15.2 ± 13.9	* *
Next dentist	30.6 ± 18.6	25.4 ± 15.6	32.4 ± 19.2	* *

Ning et al conducted a RCT that examined the effect of a group program involving four sessions in which 12 patients (aged from 20 to 56 years) were taught anxiety

management skills. Patients were randomly assigned to a massed or spaced treatment condition.[169] The results showed that there was a significant overall decrease in DA over time [$F(4,7) = 67.60$, $p<0.001$]; however, the group differences were not significant.

Seyrek et al investigated three different types of distraction in 80 college students receiving amalgam restorations in a dental clinic.[175] The interventions included an audio-comedy program, a video-comedy program, and a video game and the results showed that both the video comedy and the video game were effective in distracting patients during the dental procedure; however, successful distraction was accompanied by an increase in physiologic arousal.

Smith et al described and evaluated the operation of a Dental Fears Research Clinic at the University of Washington, Seattle. The study involved 56 patients (mean average age of 37 years) who attended the clinic.[176] The dental fear treatment strategies included: adjusting conventional dental treatment to increase patient perceived control and comfort; and increasing patient coping skills through behavioural therapy, which was supplemented by basic cognitive coping strategies, thought stopping, substitution or assertiveness and distraction such as music or hypnosis. The DFS score showed a statistically significant decrease from 73% prior to the appointment to 49% after the appointment. In addition, the Getz's results showed a decrease from 65% to 33% after treatment, which was a statistically significant change in the average item response from 3.75 to 1 .63.[176]

Children/Paediatric patients

Carson & Freeman conducted a RCT to assess TSD in 200 children (aged from 5 to 11 years) referred in pain for GA extractions and were randomly divided into intervention (TSD) and control groups (children were given motivator badges).[142] Results showed that the mean rank score for observed anxiety was lower at the initial visit for the control group when compared with those children in the intervention group. The children in the TSD group had significantly lower rank mean scores for observed anxiety status compared with the intervention group's children in the waiting room and prior to induction at the GA visit. Interestingly, it was found that there was no reduction in heart rate in children who had previous experience of GA in the TSD group (Table 41).[142]

Table 41 Comparisons of dental anxiety status between intervention and control children

Observed anxiety scale	Intervention group (Rank mean) (n =100)	Control group (Rank mean) (n =100)	U	Z	p value
the initial visit: in the waiting room	119.20	81.78	3127.5	4.71	<0.001
the GA visit: in the waiting room	90.19	110.81	3969.0	-2.60	<0.001
the GA visit: in the dental surgery prior to induction	91.20	106.57	4093.0	-1.89	<0.001

U - Mann-Whitney U test, Z – chi square analysis

The subjects in the intervention group had significantly lower mean scores for heart rate prior to induction and prior to extraction compared with those in the control group. No other significant differences could be demonstrated (Table 42).[142]

Table 42 Comparisons between intervention and control groups for heart rate prior to and after general anaesthesia

Heart rate (bpm)	Intervention group (Mean±SD) (n=100)	Control group (Mean±SD) (n=100)	t	p value
in the dental surgery prior to induction	82.50 (±11.7)	86.70 (±9.0)	2.85	<0.001
in the dental surgery after induction	97 (±9.1)	100.60 (±10.2)	2.60	0.01
in the dental surgery during extraction	114 (±12.6)	113.8 (±14.4)	-0.25	0.81
in the dental surgery after GA	107.8 (±11.0)	108.5 (±13.7)	0.38	0.70

t – t test

de Menezes Abreu et al determined whether gradually exposing Brazilian children (n=302, aged 6-7 years) to the dental environment would decrease their levels of DA over a 14.5-month period.[144] The dental treatments included conventional treatment, ART and ultra conservative treatment. Dental anxiety was assessed using the FIS at five time points: 1) before an epidemiological examination; 2) before the first treatment session; 3) before the second treatment session; 4) before the first evaluation session 5) before the second evaluation session. It was found that there was a statistically significant decrease in levels of DA between time points 1 and 5 and 89% of the children with FIS score 1 or 2 at baseline had the same scores at the last time point, whereas 82% of children with FIS score 4 or 5 at baseline had a FIS score of 1 or 2 at the last time point. The mean and standard deviation of the FIS scores at the five time points are presented in Table 34. The results of the Student-t tests showed that the DA of the children at time point 1 was statistically significantly higher than at time points 2 to 5. There was no statistical difference in the children's DA between time points 2 and 3, and between time points 4 and 5 (Table 43).[144]

Table 43 Mean and standard deviation (SD) of dental anxiety scores (FIS) by time point

Time point	N	Mean	SD
1) FIS EPI	302	2.3	1.2
2) FIS Tx-1	302	2.0	1.0
3) FIS Tx-2	302	1.9	1.0
4) FIS Ev-1	278	1.7	0.8
5) FIS Ev-2	259	1.7	0.9

N=number of children; EPI=epidemiological examination; Tx-1=first treatment session; Tx-2=second treatment session; Ev-1=first evaluation session; Ev-2=second evaluation session

Two studies compared mastery and coping models in the reduction of relatively high fear and fear-related behaviours. Ginther & Roberts conducted a trial in 60 children (aged 4-12 years) undergoing dental treatment who were grouped according to previous dental experience; i.e. none vs previous.[151] Children were allocated to one of the three groups: a coping model slide-and-audiotape presentation, a mastery model presentation, or a no-slide-presentation condition. There were no statistically significant differences on the dependent measures due to the model intervention, model type, and due to level of previous dental experience. Similarly, McMurray investigated the effects of mastery and coping models on anxiety and disruptive behaviours in 24 children (aged 5-7 years) undergoing a restorative dental procedure.[163] In contrast to the study by Ginther & Roberts[151], the results from this study[163] showed that both the interventions were more effective in reducing self-report anxiety compared to a placebo; however, there were no significant differences between the two interventions in reducing anxiety. Mean change (from pre- to post-treatment) in scores on the pictorial version of Corah's DAS was -2.50 and -3.50 respectively.

Heitkemper et al in a RCT investigated the effect of paced respiration and cognitive coping on DA in sample of 45 children (aged from 8 to 11 years).[152] Results showed that there was a significant decrease in State-Trait anxiety scores and expected discomfort in the paced respiration group compared to cognitive coping and placebo groups. The mean and SD STAI scores from pre-test to post-test in the paced respiration group and cognitive coping group were 35.8 ± 4.5 to 28.8 ± 2.8 and 33.4 ± 5.2 to 29.4 ± 3.0, respectively compared to the placebo group (32.7 ± 5.2 to 31.1 ± 4.2).[152]

Melamed et al in 1983 investigated the effect of four different reinforcement behaviour conditions on dental fear in 42 children (aged from 4 to 12 years) undergoing routine dental treatment and these four conditions were positive reinforcement, punishment, positive reinforcement and punishment and neutral.[164] Results showed that children in the punishment condition group showed a significant reduction in sweating before and

after the treatment. However, most significantly, it was found that repeated exposure to dental treatment procedures resulted in significant reductions in DA.

Mungara et al examined the effect of AV modelling on dental fear of 90 children using CFSS-DS, where participants were assigned equally to experimental group and control group.[168] Results showed that there were no statistically significant differences in the overall mean CFSS-DS scores between the two groups during the initial session ($p>0.05$). However, in the final session, a statistically significant difference was observed in the overall mean fear scores between the groups ($p<0.01$). There was a significant improvement in the experimental group, with no significant change in the control group (Table 44).

Table 44 Comparison of the mean fear scores (CFSS-DS) between the study groups during the experimental period

Group	Pre-intervention (mean ± SD)	Post-intervention (mean ± SD)	Pre- vs post-comparison (p value)
Group I	30.2 ± 6.163	23.27 ± 4.629	0.000
Group II	30.33 ± 6.421	30.64 ± 6.072	0.486
P value	0.989	0.000	

Prins in 1988 conducted two experimental studies. In the first study three different interventions were compared in 30 children (aged 8-12 years) with dental fear.[173] Children were assigned to one of the three intervention groups: training in threat-related verbal coping responses group, training in competence-related verbal coping responses group, and training in an emotive-imagery procedure. The control group was a placebo or a no-treatment control group. Results showed that there was a significant reduction in DA across all groups; however, there were no significant differences between groups. In the second study, 29 patients (aged from 8-22 years) with high dental fear were assigned to a competence-related self-speech group, an emotive-imagery, or a no-treatment control group. Results indicated that there was no reduction in anxiety across all the three groups. It was unclear why they were contrasting results from the two studies, which might negate the conclusive efficacy of self-instructional training as a method to reduce high dental fears in children.[173]

Venham et al conducted a RCT that evaluated the effectiveness of a distraction technique in reducing young childrens' (n = 55, aged from 2-6 years) DA.[178] Children in the distraction group viewed familiar children's television programs throughout their dental visits (an initial examination, two treatment visits, and a polish visit and all visits), and

children in a control group had no exposure to the distraction stimulus. The results showed that there was no effect of the distraction technique on children's responses to specific dental procedures within visits.

Acceptance and Preferences

The following section includes experimental studies that evaluated the acceptability and preferences of patients and/or their parents towards BMTs and also cross-sectional studies, mostly surveys. Almost all the experimental studies on the acceptance and preferences of BMTs included paediatric patients and/or their parents, except for one study[148] which included adult patients.

Experimental studies

Elango & Shivaprakash conducted a quasi-experimental study to evaluate the attitudes toward behaviour techniques among parents of healthy in Indian subpopulation, wherein parents of healthy children watched videotape vignette of 10 BMTs (TSD, positive reinforcement, live modelling, contingent escape, mouth prop, voice control, physical restraint by the dentist, HOM, oral sedation, and GA) in groups and rated them using VAS.[146] All the parents reported all the techniques as acceptable (Table 45). The most preferred technique by the subjects was contingent escape, followed by TSD. Voice control and HOM were the least accepted techniques in both groups. A total of 25.49% of parents in the group did not accept the use of HOM.

Table 45 Ranking of BMTs based on mean VAS scores of Group A parents

Technique	Mean	Rank	Acceptability in %
Contingent escape	8.19	1	91.81
TSD	9.30	2	90.70
Positive reinforcement	10.57	3	89.43
Mouth prop	10.68	4	89.32
Live modelling	11.48	5	88.52
Physical restraint by the dentist	14.77	6	85.23
Voice control	22.43	9	77.57
HOM	27.86	10	72.14

Forbes et al in a study determined the acceptability of behavioural therapy as rated by adult patients (n=120) with dental phobia.[148] It was found that treatment outcome had a strong effect on rated acceptability ($F = 115.76$, $P < 0.001$) and there was a weaker effect

of treatment type ($F = 5.49$, $P < 0.05$) with behavioural therapy rated as more acceptable than intravenous sedation. As in other similar studies, the acceptability of behavioural approaches to management was influenced by the perceived outcome of the treatment.

In another study conducted by Kantaputra et al that evaluated how children (n=240, aged from 6 to 17 years) felt towards the BMT used in the dental office, each student was asked to watch 8 video vignettes of live BMTs, which consisted of: TSD; rewards; GA; papoose board; hand-holding; mouthprop; voice control; and HOM. Children in this study were instructed to express their attitude towards the BMT by drawing a 'line of favour' (LOF)-a newly invented attitude meter, which was designed to measure the attitude of the children toward each BMT.[154] It was found that TSD and HOM were the most and least favourite BMT. In addition, it was found that older and younger children had different opinions towards some BMTs. The older children preferred the papoose board and hand-holding to the mouthprop and all children preferred the use of the papoose board and hand-holding to voice control. The most popular BMTs, in the decreasing order of acceptance/preference were TSD; rewards; GA; papoose board; hand-holding; mouthprop; voice control; and HOM.

Kuscu et al in a quasi-experimental study conducted in Istanbul determined the effectiveness of nonaversive BMTs by the ratings of parents who had observed their children (n=25, aged from 5 to 13 years) during three sequential dental treatment sessions.[158] Parents rated the effectiveness of each BMT on a 10-grade VAS after watching a descriptive video on eight widely-accepted BMTs. Results showed that all nonaversive BMTs were considered by the parents to be very effective on children's favourable behavior with a mean VAS score of 9.25. Perceived control and positive reinforcement were rated the most (VAS score: 9.80 and 9.52; $P > 0.05$).

Owusu et al examined the attitudes of parents of children (n=344, aged from 4 to 9 years) towards BMTs in a paediatric dental clinic in Saudi Arabia.[170] Results showed that the most preferred nonpharmacological technique was TSD (49.3%), followed by voice control (8.5%), and restraint (3.8%). In comparison, the actual BMTs used by dentists included TSD (74.5%), followed by voice control (56.2%), manual restraint (25.5%), and Papoose board (11.2%). Similarly, Peretz & Zadik in a quasi-experimental study investigated attitudes towards BMTs in a sample of 104 parents, whose children attended the paediatric dentistry department in Jerusalem, Israel.[172] Results showed that voice

control (53%) was the most completely accepted nonpharmacological technique, followed by Papoose board (31%) and restraint (22%). In terms of results related to dentists' behaviour management, the results showed that most of the dentists preferred to use BMTs (64%), followed by pharmacological approaches. Manual restraint was only used in 18 children.

Utilisation of BMTs by dentists including general dental practitioners and specialist dentists/paediatric dentists

Cross-sectional studies, mostly surveys

Fifteen cross-sectional studies[130-133, 135, 140, 143, 145, 155, 162, 167, 171, 177, 179, 180] that mostly included surveys reported on the preferences, acceptance and utilisation of various behavioural anxiety management techniques. The following table (Table 46) illustrates the frequency distribution of the various BMTs as used by the dentists (both general dental practitioners (GDPs) and specialist or paediatric dentists (PDs), where reported).

Table 46 Dentists' use of various BMTs and Parents' acceptance and preferences for various BMTs

Author/Year	TSD n (%)	Positive Reinforcement n (%)	HOM n (%)	Physical Restraint/Passive immobilisation^ n (%)	Distraction n (%)	Voice Control n (%)	Parent's presence or absence n (%)	Non-verbal Communication/verbal communication n (%)	Modelling n (%)
Dental practitioners									
Abushal & Adenubi 2000[130] – GDPs (n = 177)	162 (91.5 %)	147 (83.1 %)	114 (64.4 %)	76 (42.9 %)	89 (45.2 %)	146 (82.5 %)	125 (70.6 %)	70 (39.5 %)	74 (41.8%)
Abushal & Adenubi 2000[130] – Paediatric dentists (n = 55)	54 (98.2 %)	53 (96.4 %)	33 (60.0 %)	33 (60.0 %)	31 (56.4 %)	51 (92.7 %)	39 (70.9 %)	34 (61.8%)	34 (61.8%)
Adair et al 2004[132]	99%	99%	21%	68%	96%	92%	-	91%	-
Adair et al 2007[131] – Males <46 years	602 (99%)	601 (99%)	117 (19%)	412 (68%)	585 (97%)	556 (92%)	-	245 (91%)	-
Adair et al 2007[131] – Females <46 years	693 (100%)	689 (99%)	94 (14%)	510 (74%)	680 (98%)	619 (89%)	-	608 (88%)	-
Adair et al 2007[131] – Males >46 years	1172 (99%)	1170 (99%)	304 (26%)	763 (65%)	1118 (95%)	1123 (95%)	-	1096 (93%)	-
Adair et al 2007[131] – Females <46 years	210 (99%)	209 (99%)	40 (19%)	143 (67%)	201 (95%)	185 (88%)	-	192 (91%)	-
Ajlouni et al 2010[133] – Paediatric dentists (n=43)	39 (100%)	32 (82%)	16 (41%)	8 (21%)	29 (74%)	34 (87%)	-	23 (59%)	31 (79%)

Kawia et al 2015[155] (n=74)	74 (100%)	68 (91.9%)	22 (29.7%)	73 (98.6%)	64 (86.5%)	69 (93.2%)	71 (95.9%)	68 (91.9%)	67 (90.5%)
McKnight-Hanes et al 1993[162] - GDPs	96%	-	21%	3%	-	88%	-	-	-
McKnight-Hanes et al 1993[162] – Paediatric dentists	100%	-	52%	71%	-	98%	-	-	-
Strøm et al 2015[177]	340 (87%)	-	-	-	94 (25%)	-	-	-	-
Parents of children/Patients									
Alammouri 2006[135] (n=138)	92.8%	91.3%	9.4%	23.9%	76.8%	56.5%	55.1%	55.8%	-
Boka et al 2014[140] (n = 106)[#]	9.76 ± 0.69	-	-	4.21 ± 3.84	-	-	-	-	-
Davies & Buchanan 2013[143] (n =162)	2.04 ± 1.13	1.80 ± 0.88	-	-	1.69 ± 1.03	3.03 ± 1.30	-	1.70 ± 0.94	-
Eaton et al 2005[145] (n=46)	7.8 ± 11.2	-	77.2 ± 24.3	49.7 ± 32.1	-	27.7 ± 21.4	-	-	-
Muhammad et al[167] 2011	117 (99.2%)	118 (100%)	6 (5.1%)	36 (30.5%)	117 (99.2)		61 (51.7%)	118 (100%)	113 (95.8%)
Patel et al 2016[#][171]	-	-	-	44.4 ± 39.4	-	-	-	-	-
Venkataraghavan et al (2016)[179] – Examination*	39 (76.5%)	8 (15.7%)	-	-	-	-	4 (7.8%)	-	-
Venkataraghavan et al (2016)[179] – Caries removal*	43 (84.3%)	6 (11.8%)	-	-	-	2 (3.9%)	-	-	-
Venkataraghavan et al (2016)[179] – LA*	43 (84.3%)	6 (11.8%)	-	2 (3.9%)	-	-	-	-	-
Venkataraghavan et al (2016)[179] – Emergency*	44 (86.3%)	4 (7.8%)	-	3 (5.9%)	-	-	-	-	-

^passive immobilisation of nonsedated child; [#]mean ± SD values reported; *most preferred percentages

Abushal & Adenubi conducted a survey study in Saudi Arabia to examine the use of behaviour management techniques (BMTs) among dentists.[130] Results indicated that the paediatric dentists (PDs) utilised a wider variety of management techniques than the general dental practitioners (GDPs). The most frequently used techniques were: tell, show & do (TSD), positive reinforcement and voice control, while the three least used were intravenous sedation, non-verbal communication and extra-oral physical restraint. The BMTs were used mostly with the children aged 3 to 5 years, followed by children aged 6 to 8 years. The BMT were least required in children more than 12 years old. Techniques such as TSD and positive reinforcement were the most acceptable non-pharmacological BMTs to the parents while hand over mouth (HOM), extra-oral physical restraints and parents' separation were the least acceptable to parents. The parents had no objections to TSD and positive reinforcement.[130]

Adair et al conducted two survey studies in the USA; one to determine the use of BMTs by the American Academy of Paediatric Dentistry (AAPD) members[132] and the other to evaluate differences in the use of BMTs among older and younger male and female paediatric dentists[131]. Adair et al in 2004 conducted a survey to determine the use of BMTs by the AAPD members.[132] Results showed that communicative techniques were widely used, except the HOM intervention. In addition, it was found that there was a little change in technique use over time, except that 50% of respondents indicated they used HOM less now compared to 5 years ago, and also 24% plan to use it less over the next 2 to 3 years.

The majority of practitioners indicated that in children aged from 3 to 12 years, they used: TSD; nonverbal communication; voice control; positive reinforcement; and distraction. Active and passive immobilisation for nonsedated children were used by a majority of dentists in children aged from <3 to 5 years. HOM was not used by 79% of practitioners. Those who did use the technique, used it most frequently in children aged from 3 to 5 years.[132] Adair et al in 2007 conducted another survey study to evaluate differences in the use of BMTs among older and younger male and female paediatric dentists.[131] Results showed that there were no significant differences by groups for use of most basic BMTs; however, significant differences by gender/age distribution were seen for the use of non-verbal communication and advanced techniques. Most differences in anticipated changes in technique use were age-related. Younger females were significantly less likely to indicate the use of nonverbal communication, which was

used by a large majority of respondents in each gender/age category. Younger females were significantly less likely than older males to use HOM, a technique used by a minority of all respondents and younger females were significantly more likely than males to report use of distraction.[131]

Ajlouni et al conducted a survey study to investigate and identify the BMTs commonly used by paediatric dentists in Jordan, and their attitudes toward these methods.[133] The study showed that there was an increase in utilisation of certain techniques as TSD, normal conversation, and positive reinforcement, while there was a reduction in the use of HOM through the years of experience. The majority of paediatric dentists used different BMTs, such as TSD, voice control, modelling, distraction, and normal conversation. Most paediatric dentists preferred parental presence during treatment and with more experience there was a reduction in the utilisation of HOM among other techniques. It was further reported that the majority of the dentists with more than five years of experience were always utilising BMTs.[133]

McKnight-Hanes et al in a survey study reported the various BMTs employed by GDPs and paediatric dentists for child dental patients in the United States.[162] Survey results revealed that the paediatric dentists employed a wide range of BMTs compared to the general dentists, with those in the 40- to 49-year-old age group reportedly using the broadest spectrum of BMTs. One hundred per cent of the paediatric dentists and 96% of the general dentists reported using TSD, while 98% of the paediatric dentists and 88% of the general dentists reported using voice control. The use of HOM was reported by 52% of the paediatric dentists and 21% of the general dentists ($p<0.0001$). Physical restraint was reportedly employed by 71% of the paediatric dentists but only by 3% of the general dentists ($p<0.0001$).[162]

Strøm et al explored the dentists' (n=391) attitudes towards patients with DA and dentists' use of BMTs in a survey.[177] Results showed that younger dentists (<40 years) reported treating a higher proportion of patients with DA than their older colleagues (55 vs. 38%, $p = 0.001$). The following were the most common attitudes towards treating young patients with DA: it feels like contributing (72%, n = 286), it is difficult or tiresome (54%, n = 215) and it is a positive challenge (51%, n = 203). The most frequently used BMT was TSD (87%, n = 340), followed by relaxation (35%, n = 132), distraction (25 %, n = 94), systematic CBT (22%, n = 84) and conscious sedation (18%,

n = 69). Dental treatment under nitrous oxide sedation (2%, n = 8) and hypnotherapeutic techniques (1%, n = 4) were rarely reported as used 'often'. The use of TSD was reported more often by female dentists (90 vs. 82%, p = 0.046).[177]

Acceptance of BMTs by parents of children or children attending a dental centre or undergoing dental treatment

Alammouri investigated the attitudes of 138 parents of children towards behaviour management techniques used in paediatric dentistry attending a dental centre in Jordan.[135] Overall, the survey results showed that parents had positive attitudes towards TSD, positive reinforcement and distraction. In addition, the majority of the parents did not accept the use of HOM and physical restraint. Boka et al conducted a survey study to examine the acceptance by Greek parents of nine BMTs.[140] One hundred and six parents whose 3- to 12-year-old children had been receiving treatment in a university postgraduate paediatric dental clinic, and 123 parents of children from a private paediatric dental practice were recruited. The best accepted non-pharmacological techniques were tell-show-do (9.76 ± 0.69), followed by parental presence/absence (PPA) technique (7.83 ± 3.06). Tell–show–do and PPA mean values were statistically significantly different from all the other techniques, while the mean value of tell–show–do was statistically significantly higher than the mean value of acceptance of PPA. The least accepted nonpharmacological technique was passive restraint by Papoose Board (4.21 ± 3.84).[140]

Davies & Buchanan conducted an exploratory study to explore acceptability of BMTs by children (aged 9 to 11 years) in South-West England.[143] Participants' perspectives of BMTs were assessed twofold: qualitatively, through asking the child their experiences and perceptions of each BMT and quantitatively through using the acceptability scale. Results indicated that children generally perceived the BMTs as acceptable or neutral; stop signals were the most acceptable, and voice control the least acceptable BMT. Children also reported that distraction and positive reinforcement were helpful and beneficial to them. Children's perceptions of BMTs were explored through thematic analysis of the interview data. The findings from thematic analysis revealed some emergent themes with regards to participants' experiences and views. Verbal and non-verbal communication emerged as central themes relating to good communication by their dentists and almost a third of participants stated the main reason they felt their

dentist was friendly was because they talked appropriately to them as patients. As one 11-year-old girl said "She…talks to you, and helps you understand stuff a bit better." Children with lower DA felt that the dentist's use of voice control was justified and reasonable, so that treatment could be performed, as one 10-year-old girl (moderate DA) said "They're [the dentist] only trying to do their job, they're not…trying to be mean to you or anything."[143]

Majority of the participants reported experiences of positive reinforcement and over half of the children reported receiving stickers as a positive aspect of attending, which were perceived as being a personal reward for a number of different behaviours, as one 11-year-old girl stated "Sometimes going to the dentist wasn't exactly fun…I would quite enjoy that [receiving a sticker], cos then it's like a reward for actually coming".[143] Tell–Show–Do technique was perceived as moderately acceptable and children reported two significant benefits with TSD: being informed and reducing anxiety. Children also felt that providing prior information of the procedure was beneficial, which familiarised them with the procedure and provided control. As one 10-year-old girl said, "It just makes me feel more safe seeing dental tools, because I know what they're gonna do and I know what's gonna happen". However, there were some participants who felt that there was a negative consequence of TSD with its potential to increase anxiety because of viewing, and explanation of, the dental instruments.

One-fifth of the participants reported the use of stop signals at their dentist and the benefits included – relief of worry, distress, and physical discomfort, as one 9-year-old girl said "You feel really nervous, and sometimes it takes quite a long time. So it's just, a lot better with a break." Distraction was perceived as highly acceptable and the most commonly reported type experienced by these participants was visual-based stimuli including pictures on display and music. Benefits of distraction included diverting attention, relaxation, and decreased anxiety. In addition, audio distraction further aided coping with the sounds of dental treatments, as one 11-year-old girl said - "You're…listening [to music], instead of listening to the noises in your mouth…you kind of forget about the tooth".[143]

Eaton et al (2005) conducted a survey study was to examine parental (n = 46) attitudes toward BMTs currently used in paediatric dentistry.[145] Parents rated their acceptance of each technique using a VAS (0 to 100 mm scale) and TSD was rated as the most

acceptable technique, followed (in order of decreasing acceptance) by: active restraint; voice control; passive restraint; and HOM. Hand-over-mouth and passive restraint were rated as the least acceptable techniques.[145] Enneking et al examined the clinical treatment outcome for dental fears through retrospective reviewing of 111 patient records.[147] Review of records showed that patients either received behavioral therapy alone or behavioral therapy with a nitrous oxide or IV sedation adjunct. All patients successfully completed initial dental treatment and relapse of fear requiring additional psychological treatment occurred only in the non-specific fear subtype (rate = 11.2%). Overall, patients who received pharmacologic adjuncts (nitrous oxide) to behaviour therapy experienced less relapse.[147] Kawia et al investigated oral health care providers' awareness, use and factors for choice of behavior management techniques when attending paediatric dental patients in Dar es Salaam, Tanzania.[155] Results showed majority of the dental practitioners were aware of and used various BMTs, ranging from 100% for Tell-Show-Do to 86% for distraction.

Kroeger & Smith described the outcome of a survey results on a behaviour fear control program that consisted of progressive muscle relaxation, guided imagery, modelling, systematic desensitisation and distraction.[156] The survey was conducted three years after the completion of the fear control program in a sample of 46 adult patients. The results showed that in the majority of the survey respondents (98%), dental fear reduced and the program helped them gain more trust with the dentists. In addition, patients felt that they were able to complete the required dental treatment without any undue fear or anxiety. Further, the survey results revealed that in more than 90% of the respondents, discussing fear with the dental assistant, watching videotape, and muscle and guided imagery relaxation was little helpful. More than 93% of the patients rated home based practice of muscle relaxation and 84% rated relaxation with desensitisation as helpful.[156]

Muhammad et al conducted a survey to evaluate the parental (n=118) attitudes toward different BMTs used during dental treatment of schoolchildren in Kuwait.[167] Survey revealed that positive reinforcement, effective communication, TSD, distraction, modelling and nonverbal communication were the most approved techniques and hypnosis and parental separation were moderately approved techniques. Voice control, protective stabilisation (physical restraint), HOM were the least approved

nonpharmacological techniques.[167] Patel et al examined parental (n=105) attitudes towards four advanced BMTs in pediatric dentistry and additionally, determined whether cost, urgency, and amount of treatment influence parental preferences.[171] Oral sedation was rated as the most acceptable technique, followed by GA, active immobilisation, and passive immobilisation. Parental acceptance of the technique increased as the urgency, convenience, and previous experience increased and as cost of treatment increased, parental acceptance decreased.[171] Venkataraghavan et al assessed the parents' (n=51) acceptance towards BMTs commonly used in the pediatric dentistry in various dental situations such as dental examination, caries removal, LA administration and emergency dental situation.[179] Results indicated that the most preferred BMT was TSD followed by positive reinforcement and the least preferred BMT was GA followed by physical restraint.

Weerheijm evaluated the experiences of children with dental fear who had undergone treatment at a Dutch Special Dental Care Centre (SBT) in terms of the decrease in anxiety levels.[180] It was reported that within one to two years after the experiences at SBT, 90 percent of the children visited a family dentist, 60 percent of them required restorative treatment and 80 percent of this treatment was performed, using LA. In addition, parents reported a decrease in their children's dental anxiety, when leaving the SBT and the level of anxiety was unchanged after one to two years visiting a family dentist.

Case reports

Two studies described patient cases wherein behavioural interventions were utilised to alleviate dental anxiety.[161, 174] McDonnell-Boudra et al in a case study detailed the assessment and treatment of an uncomplicated needle phobia using in vivo graded exposure.[161] It was shown that early intervention plays a role in the reduction of dental phobic anxiety in the dental setting. In another case study, Sanders & Jones described the use of a multi component behavioural programme in the treatment of a 13-year-old girl with multiple phobias of injections, dental and medical procedures. The treatment involved coping skills training, systematic desensitisation, in vivo desensitisation with participant modelling and homework assignments.[174] Measures of anxiety via SUDS rating (client's rating of the highest level of anxiety experienced), behavioural approach

tests and self-report measures showed that the treatment program was effective in the short term as well as at 8 months follow-up.

Expert opinion

Three expert opinion/consensus articles, all written by authors (AAPD, Kroeger and Melamed) based in the US suggest that BMTs are an integral part of an anxiety management protocol and the dentists should be aware of the various techniques to treat dental anxiety, fear and phobia in both paediatric and adult patients.[55, 157, 165] The AAPD provides comprehensive guidance on behaviour management based on expert consensus. The conclusion from these papers have been summarised into one synthesised finding using the JBI NOTARI tool as shown in Figure 12.

Figure 12 Synthesised finding from three expert opinion articles (NOTARI)

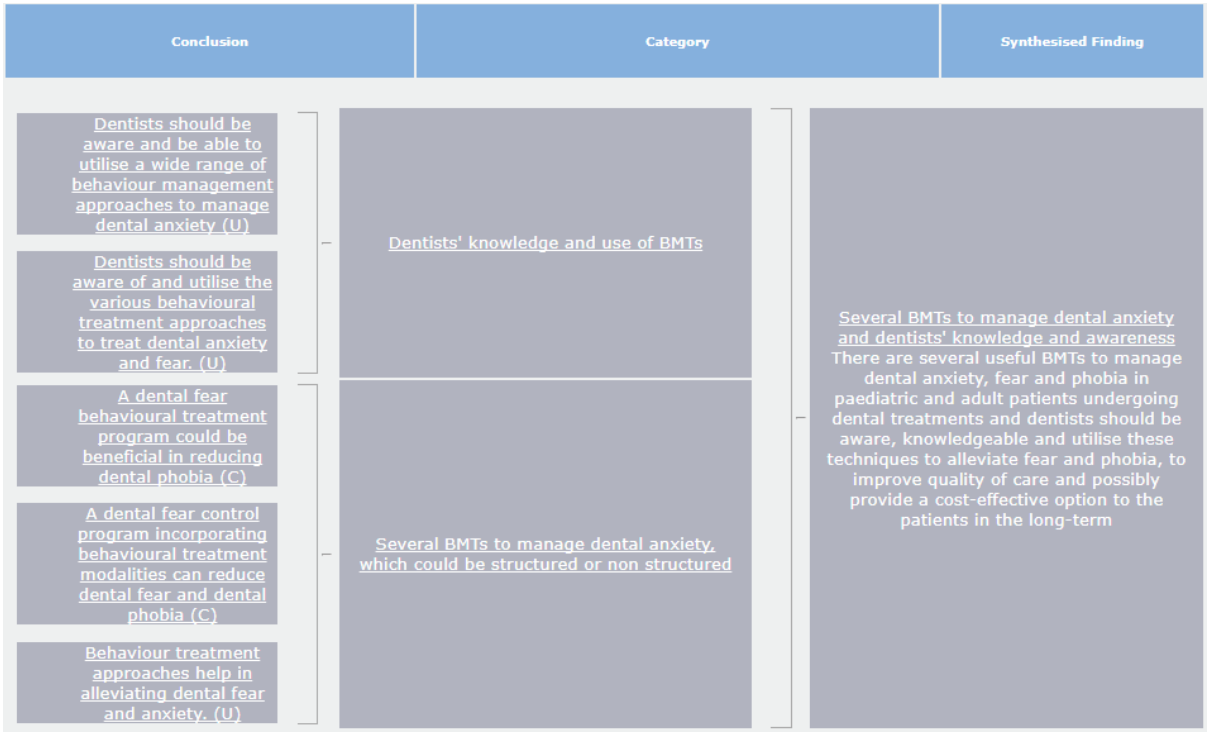


Table 47 Assessment of methodological quality (Behaviour Therapy/BMTs)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Aartman et al 1999	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Aartman et al 2000	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
AAPD 2014	Expert consensus	Y	Y	Y	Y	Y	Y	Y				I	7
Abushal & Adenubi 2000	Survey	U	Y	N	N	Y	N	N	N	Y		I	3
Adair et al 2007	Survey	U	Y	N	N	Y	Y	N	N	Y		I	4
Adair et al 2004	Survey	U	Y	N	N	Y	Y	N	N	Y		I	4
Ajlouni et al 2010	Survey	U	Y	N	N	Y	N	N	N	Y		I	3
Al Jaafer et al 2007	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Alammouri 2006	Survey	U	Y	N	N	Y	N	N	N	Y		I	3
Babu et al 2012	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	U	Y	E	4
Baker 1982	RCT	Y	N	U	N/A	N	U	Y	Y	Y	Y	I	5
Beck 1978	RCT	U	N	N	N	N	U	Y	Y	Y	U	E	3
Berggren & Linde 1984	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Berggren 1986	Cohort study	Y	Y	U	N	Y	Y	N	Y	Y		I	6
Berggren & Carlsson 1986	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Boka et al 2014	Survey	N	Y	U	Y	U	N/A	N	U	Y		I	3
Carpenter et al 1994	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Carr et al 1999	Survey	U	Y	N	N	U	N	N	N	Y		E	2

Carson & Freeman 1998	RCT	U	N	N	N/A	Y	U	Y	Y	Y	Y	I	5
Clark & Hirschman 1980	RCT	N	N	N	N	N	U	U	U	U	U	E	0
Corah et al 1981	RCT	U	N	N	N/A	N	Y	Y	Y	Y	Y	I	5
Crossley & Joshi 2002	Survey	N	Y	N	N	U	N	N	N	Y		E	2
Davies & Buchanan 2013	Qualitative study & survey	Y	Y	Y	Y	Y	N	N	Y	Y	Y	I	8
de León et al 2010	Survey	N	Y	N	N	U	N	N	N	Y		E	1
de Menezes Abreu et al 2011	Quasi-experimental study	U	N	N	Y	N	Y	Y	Y	Y	Y	I	6
Eaton et al 2005	Survey	U	Y	N	Y	U	N	N	Y	Y		I	4
Enneking et al 2012	Survey	U	Y	N	Y	Y	N/A	N	Y	Y		I	5
Elango & Shivaprakash 2012	Quasi-experimental study	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Forbes et al 2012	Quasi-experimental study	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Gatchel 1986	RCT	U	U	N	N	N	Y	Y	Y	Y	Y	I	5
Gitin 1997	RCT	U	N	N	N	Y	Y	Y	Y	Y	Y	I	6
Ginther & Roberts 1982	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Grewal 2003	Survey	U	Y	N	N	U	N	N	N	Y		E	2
Heitkemper et al 1993	RCT	U	N	N	N	U	Y	Y	Y	Y	Y	I	5
Jerremalm et al 1986	RCT	U	Y	N	N	Y	Y	Y	Y	Y	Y	I	7
Kamolmatayakul & Nukaw 2002	Survey	U	Y	N	N	N/A	N	N	N	Y		E	2
Kantaputra et al 2007	Quasi-experimental study	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Kawia et al 2015	Survey	U	Y	N	N	Y	N	N	N	Y		I	3

Krochak et al 1988	Case report	Y	Y	U	N	N	N	N	U	Y	N	E	3
Kroeger 1986	Expert opinion	Y	Y	Y	Y	N	Y	U				I	5
Kroeger & Smith 1989	Descriptive study	Y	Y	N	Y	Y	N/A	U	Y	Y		I	6
Kuşcu et al 2014	Quasi-experimental study	U	N	N	N	N	U	Y	Y	Y	Y	I	4
Kvale et al 2002	Quasi-experimental study	N	N	N	N	N	U	Y	Y	Y	Y	I	4
Lamb & Strand 1980	RCT	U	N	N	N/A	N	U	Y	Y	Y	Y	E	4
Liddell et al 1994	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Litt et al 1999	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Makkes et al 1987	Quasi-experimental study	N	N	N	N	N	U	U	Y	U	U	E	1
Mathews & Rezin 1977	RCT	U	N	N	N	N	U	Y	Y	U	Y	E	4
McDonnell-Boudra et al 2014	Case report	Y	Y	U	N	Y	N	N	Y	Y	Y	I	6
McKnight-Hanes et al 1993	Survey	Y	Y	N	N	Y	N	N	N	Y		I	4
McMurray et al 1985	RCT	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Melamed et al 1983	RCT	U	N	N	N	Y	Y	Y	Y	Y	Y	I	7
Melamed 1984	Exp opinion	Y	Y	Y	Y	N	N	Y				I	5
Moore et al 1991	RCT	U	N	N	Y	N	U	Y	Y	Y	Y	I	5
Morse et al 1981	RCT	U	N	N	N/A	N	U	Y	Y	Y	Y	E	4
Muhammad et al 2011	Survey	Y	Y	N	N	Y	N	N	N	Y		I	4
Mungara et al 2013	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Newton & Sturmey 2003	Quasi-experimental study	U	N	N	N	N	U	Y	Y	Y	Y	I	4

Ning & Liddell 1991	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Oredugba & Sanu 2009	Survey	U	Y	N	N	N/A	N	N	N	Y		E	2
Owusu et al 2005	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Patel et al 2016	Survey	N	Y	U	Y	U	N	N/A	Y	Y		I	5
Peretz & Zadik 1999	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Prins 1988	Quasi-experimental study	N	N	N	N	N	U	Y	Y	Y	Y	I	4
Sanders & Jones 1990	Case report	Y	Y	N	N	U	N	U	Y	Y	Y	I	5
Schmid-Leuz et al 2007	RCT	U	N	N	N	N	N	U	Y	Y	Y	E	3
Seyrek et al 1984	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Smith et al 1987	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Strøm et al 2015	Survey study	Y	Y	N	N	Y	N	N	N	Y		I	4
Venham et al 1981	RCT	U	N	N	N	U	U	Y	Y	Y	Y	I	4
Venkataraghavan et al 2016	Survey	U	Y	N	Y	N/A	N	N	Y	Y		I	4
Wanderer & Ingram 1991	Case report	Y	Y	U	N	N	N	N	U	Y	N	E	3
Weerheijm et al 1999	Survey	Y	Y	N	N	Y	N	N	N	Y		I	4
Xia & Song 2016	RCT	Y	U	U	N/A	U	Y	Y	Y	Y	Y	I	6

4.4.5. Biofeedback and Desensitisation

Eight studies were included in the review (four RCTs, one block RCT, one quasi-experimental study and two cohort studies) that were relevant to biofeedback and desensitisation.[53, 182-188]

In one study by Carlsson et al, 15 patients with dental phobia were assigned to two treatment groups, one receiving systematic desensitisation and one premedicated with Valium for the two restorations. Significant differences were found between the two treatment groups on the dentist's ratings; however, second DAS, and change scores were not reflected by the physiological measures.[182]

Dedeepya et al in a crossover RCT investigated the efficacy of biofeedback (in five sessions within a 4-week interval, each session lasting for 45 min) in 40 highly anxious children receiving dental restorations.[183] Outcome measures included blood volume PR, HR and VAS. Objective outcome measures showed that biofeedback therapy in children led to lower levels of anxiety in the initial appointments; however, the subjective measures did not show any statistically significant difference (Table 48).

Table 48 Intergroup comparison of blood volume pulse and heart rate, mean & standard error (SE)

Appointment	Group (N= 20 in I & II)	Heart rate	Blood volume pulse
1	I	102.6 (2.7)	6.2 (0.7)
	II	93.6 (2.2)	4.1 (0.5)
2	I	85.6 (1.8)	5.5 (1.02)
	II	109.6 (1.3)	7.5 (0.6)
3	I	82.0 (2.3)	3.6 (0.5)
	II	83.2 (1.6)	3.6 (0.6)
4	I	78.2 (1.5)	4.1 (0.7)
	II	80.7 (1.5)	3.7 (0.8)
Follow-up	I	78.2 (1.1)	2.6 (0.3)
	II	80.9 (1.7)	3.9 (0.6)

Doering et al compared Eye Movement Desensitisation and Reprocessing (EMDR) to a waitlist control condition in 31 medication-free patients who met the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) criteria of dental phobia.[184] Dental anxiety was assessed using the DAS and DFS. Significant reductions in DA were reported in the intervention group (effect size, d = 2.52 (DAS) and d = 1.87 (DFS), which were also significant at 3 months (d = 3.28 and d = 2.28, respectively) and 12 months (d = 3.75 and d = 1.79, respectively) after treatment (Table 49).

Table 49 Outcomes measure group comparisons: intention-to-treat observed case analyses

Variable	EMDR group			Waitlist control group			Group comparison	
	Pre Post	T P value	Effect size (d)	Pre Post	T P value	Effect size (d)	F	P value
DAS	18.2 ± 1.6	8.236 <0.001	2.52	18.81 ± 1.8	0.329 0.75	0.11	41.236	<0.001
	12.2 ± 2.9			17.9 ± 1.2				
DFS	83.1 ± 8.7	6.305 <0.001	1.87	82.4 ± 10.7	1.994 0.07	0.60	23.050	<0.001
	59.9 ± 4.2			79.6 ± 10.0				

For the assessment of lasting changes, patients of both groups who had received treatment were combined and until 3 months after treatment there was a continuing decrease of DA; subsequently, this trend evened out (Tables 50 & 51).[184]

Table 50 Outcome measures at the 3-month and 12 months follow-up (n = 12)

	Pretreatment	Post-treatment	3-month follow-up	Effect size (pretreatment-3 months) d	F P value
Dental Anxiety Scale (total score)	18.1 ± 1.2	11.3 ± 2.2	10.5 ± 3.5	3.28	33.151 <0.001
Dental Fear Survey (total score)	78.3 ± 10.5	54.3 ± 14.0	48.1 ± 10.9	2.28	21.480 <0.001

Table 51 Outcome measures at 12 months follow-up (n = 6)

	Pretreatment	Post-treatment	3-month follow-up	12-month follow-up	Effect size (pretreatment-3 months) d	F P value
Dental Anxiety Scale (total score)	17.7 ± 1.1	11.2 ± 2.5	9.2 ± 3.1	10.5 ± 2.4	3.75	14.522 <0.001
Dental Fear Survey (total score)	76.2 ± 11.5	54.3 ± 13.6	42.2 ± 10.8	44.7 ± 10.7	1.79	10.468 <0.001

Hakeberg et al reported results of an intervention over a period of 10 years for 14 patients treated for dental fear in a specialised dental fear treatment and research clinic.[185] The 14 dental phobic patients were assigned to two treatment groups, Systematic

Desensitisation group and premedication with Valium group. Corah's DAS and physiological (Skin Conductance Response) measurements were the outcome measurement scales. Patient in the intervention reported a significant reduction of dental fear (DAS score). Similarly, in another follow up study including 29 patients with severe DA, modified systematic desensitisation training and biofeedback showed a significant reduction in DA during the 10-yr period except among GA patients.[186]

Moore in 1991 evaluated the effectiveness of two types of fear desensitisation in a group of 68 dental fear patients with high and low general trait anxiety.[187] It was found that there were no significant differences in dental fear reduction effects between the two types of desensitisation. However, when compared to a group of dental fear patients on a waiting list, both the treatments showed significant and meaningful effects. In patients with high general anxiety desensitisation did not show significant beneficial effects. Analysis indicated that each desensitisation group showed a significant and meaningful reduction in DA and state anxiety tendency within groups and when compared with the waiting list group at P = 0.05 (Table 52).

Table 52 Summary statistics for fear and trust scales for experimental and control groups

	Times	**Video training group (n=27)**	**Rehearsal group (n=33)**	**Control group (n=75)**
Dental Anxiety Scale (20 pt. max.)				
Pretest	(Tl) -	18.0 ± 1.6	17.9 ± 1.2	17.0 ± 2.7
Posttest	(T2) -	9.2 ± 2.6	9.8 ± 2.4	16.7 ± 2.9
Postdental Tx	(T3) -	7.2 ± 2.3	8.1 ± 2.7	
State-Trait Anxiety Inventory (STAI-S only) (80 pt. max.)				
Pretest	(Tl) -	70.4 ± 4.9	69.5 ± 8.5	68.4 ± 10.1
Posttest	(T2) -	33.4 ± 10.5	40.7 ± 9.6	69.0 ± 9.5
Postdental Tx	(T3) -	30.3 ± 8.4	34.6 ± 9.7	
Dental Beliefs Survey (75 pt. max.)				
Pretest	(Tl) -	46.8 ± 13.8	49.6 ± 9.9	
Posttest	(T2) -	20.0 ± 9.4	18.8 ± 3.9	
Postdental Tx	(T3) -	16.8 ± 3.8	18.0 ± 3.9	
Visual analogue scale (100 pt. max.)				
Pretest	(Tl) -	87.0 ± 12.7	88.5 ± 8.7	
Postdental Tx	(T3) -	14.8 ± 12.8	15.2 ± 13.9	
Next dentist		25.4 ± 15.6	32.4 ± 19.2	

Moore & Brodsgaard compared the effects of group therapy (GT) with individual treatment (IT) in patients (aged between 19-65 years) with extreme DA (who were either

starting treatment or were on the waiting list at the Dental Phobia Research and Treatment Center, Royal Dental College, Denmark).[188] Individual therapy included video training and clinical rehearsal and GT included two group sessions with orientation, relaxation training, and desensitisation procedure as in the IT group. The measures used were the DAS, the DFS, VAS, the Dental Beliefs Survey (DBS), and the STAI. Results by scales of DA, beliefs or trust in dentists, and fear of the next dentist after specialist treatment showed reduced DA and improved dental beliefs compared with a static control group of 45 patients. In patients who completed the treatment in the GT group, there was a greater DA reduction than patients in the IT group. Each experimental group showed a significant and meaningful reduction in DA and increased trust within groups as well as when compared with the waiting list group (Table 44). DFS anxiety reduction between IT groups and between IT and GT at T2 was not significant. Lower DFS scores were noted for GT than for the rehearsal IT group ($P < 0.001$), but not video at T3. VAS scores showed DA reduction for all groups after test treatment (T3) ($P< 0.001$). After one-year follow up in private practice, for those subjects who continued treatment (T3 to T4), there were DFS DA increases for all experimental groups (GT: $P<0.05$: video ITP = 0.02- rehearsal IT: $P< 0.001$) (Table 44). VAS anxiety increased for rehearsal IT ($P<0.001$) at 1-yr follow-up (T3 to T4) compared to the other two groups (Table 53).[188]

Table 53 Summary statistics (Mean ± SD) for fear and dental beliefs/trust scales for experimental and control groups (n= 129)

	Times	IT group	Video group	Rehearsal group	GT group	Control group
DFS (100 points max)						
Pretest	T1	74.4 ± 13.0	76.0 ± 12.8	73.0 ± 13.3	78.4 ± 10.3	80.9 ± 9.5
Posttest	T2	38.6 ± 11.5	39.5 ± 12.8	37.8 ± 10.5	36.5 ± 10.3	76.6 ± 15.3
Postdental Tx	T3	31.9 ± 7.8	30.1 ± 7.2	33.3 ± 8.1	27.0 ± 6.4	* *
After 1 year	T4	39.2 ± 11.7	34.9 ± 10.0	42.9 ± 12.0	29.6 ± 8.0	* *
DBS (75 points max)						
Pretest	T1	48.3 ± 11.7	46.6 ± 13.6	49.6 ± 9.9	46.6 ± 11.5	49.6 ± 12.7
Posttest	T2	19.3 ± 6.9	20.0 ±9.4	24.4 ± 3.9	18.7 ± 6.5	45.0 ± 15.9
Postdental Tx	T3	17.5 ± 3.9	16.8 ± 3.8	18.8 ± 3.9	16.2 ± 2.2	* *
After 1 year	T4	22.1 ± 10.9	19.5 ± 8.9	18.0 ± 12.0	19.1 ± 5.8	* *
VAS (100 points max)						
Pretest	T1	87.6 ± 10.3	86.7 ± 12.3	88.2 ± 8.4	88.8 ± 11.4	* *
Postdental Tx	T3	15.0 ± 13.3	14.8 ± 12.8	15.2 ± 13.9	8.3 ± 10.5	* *
Before next dentist	TEx	30.6 ± 18.6	25.4 ± 15.6	34.8 ± 20.0	23.3 ± 19.9	* *

Dentist after 1 year	T4	24.9 ± 20.4	16.5 ± 13.8	32.1 ± 22.5	10.0 ± 10.4	* *

(* = not applicable). Controls filled out test batteries once at initial registration (Tl) and again after 6 months (T2). A visual analogue scale (VAS) was also used at exiting to check each patient's perceived degree of anxiety before (Tl) and after specialist treatment (T3), as well as anxiety (TEx) about going on to a new dentist and at one year after specialist treatment (T4).

Morarend et al investigated the use of a biofeedback device (RESPeRATE^{TM}) to reduce patients' pre-operative general anxiety levels and thereby reduce the pain associated with dental injections in 81 participants.[53] Subjects in the experimental group used the biofeedback technique, while those in the control group were not exposed to any biofeedback. A significant reduction of negative feelings regarding the overall injection experience (measured by VAS) was observed with the use of the respiratory rate biofeedback device. A Dental Injection Sensitivity Survey (DISS) was used to measure patients' anxiety levels, the findings of which showed that this biofeedback technique was beneficial in alleviating DA. There was a significant difference between the treatment groups in the VAS score measuring overall injection experience (VAS #2), with a median VAS of 36.2 in the experimental group vs. 53.3 in the control group (Table 54).[53]

Table 54 Descriptors of post-intervention VAS measurements by treatment group (Mean ± SD)

	Experimental group (N = 40)	**Control group (N = 41)**	**Wilcoxon rank sum test p value**
VAS #0	32.24 ± 10.34	34.14 ± 10.10	0.40
VAS #1	52.41 ± 19.82	59.66 ± 15.47	0.17
VAS #2	38.24 ± 18.28	48.62 ± 18.50	0.013*
VAS #3	41.27 ± 19.84	46.40 ± 17.79	0.22

* ($p < 0.05$)

DISS Summary Scores by treatment group are illustrated in Table 55. There was no evidence that the experimental and control groups differed in the distribution of the post-operative summary score from the DISS ($p = 0.15$); no significant differences were found between the experimental and control groups when each of the six post-operative questions on the DISS was considered ($p>0.05$ in all instances).[53]

Table 55 DISS summary scores by treatment group (Mean ± SD)

	Experimental group (N = 40)	Control group (N = 41)	Wilcoxon rank sum test p value
Pre-op	15.05 ± 2.91	14.20 ± 3.11	0.23
Post-op	9.93 ± 2.94	8.88 ± 2.34	0.15
Change (pre-op to post-op)	-5.13 ± 2.88	-5.38 ± 2.48	0.77

Table 56 Assessment of methodological quality (Biofeedback and Desensitisation)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Camner et al 1983	Case report	Y	Y	N	N	N	N	N	U	Y	N	E	3
Carlsson et al 1980	Quasi-experimental study	N	N	N	N	N	U	Y	U	U	U	E	0
Carlsson et al 1980	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Dedeepya et al 2014	Block crossover RCT	Y	N	Y	N	N	Y	Y	Y	Y	Y	I	6
De Jongh et al 2002	Quasi-experimental study	N	N	N	N	N	N	U	Y	Y	U	E	3
Doering et al 2013	RCT	Y	N	N	Y	N	Y	Y	Y	Y	Y	I	7
Landau et al 1984	Quasi-experimental study	N	N	N	N	N	U	Y	Y	Y	U	E	3
Hakeberg et al 1990	Cohort study	Y	Y	Y	N	Y	Y	N	Y	Y		I	7
Hakeberg et al 1993	Cohort study	Y	Y	U	N	Y	Y	N	Y	Y		I	6
Moore 1991	RCT	U	N	N	Y	N	Y	Y	Y	Y	Y	I	6
Moore & Brodsgaard 1994	RCT	U	N	N	Y	N	Y	Y	Y	Y	Y	I	6
Morarend et al 2011	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Morcas 1984	Case report	Y	U	Y	N	N	N	N	U	U	U	E	2

4.4.6. Cognitive behaviour therapy (CBT)/Cognitive

Sixteen studies (eight RCTs, three quasi-experimental studies, one cross-sectional study, one qualitative study and three case reports) were included in the review that were relevant to CBT.[189-204]

Akins et al investigated two cognitively based anxiety-reduction techniques in 36 undergraduate students reporting high levels of dental fear, which included the use of images as a coping strategy and self-instructional approach.[189] Results showed that both treatments were significantly effective in reducing self-reports of discomfort. In addition, subjects who had received visual mode of information reported significantly higher levels of trait anxiety (X = 43.39) than those who received information in a verbal mode (X= 33.50).

In a RCT by Berge the effectiveness of CBT among children and adolescents with formally diagnosed intra-oral injection phobia (I-OIP) was assessed.[190] In this randomised study, 67 patients (aged from10 to16 years), fulfilling the DSM-5 criteria were randomly assigned to either an immediate treatment group receiving CBT, or a waitlist-control group. Results showed that CBT had significant effect when compared to no treatment on reducing injection phobia. However, in this study, CBT was performed by specially trained dentists, which was found to be an efficient way to treat children and adolescents diagnosed with intra-oral injection phobia.[190]

Bosmajian in 1981 compared the relative effectiveness of stress inoculation training and stress education in reducing stress related behaviours in 32 patients.[191] Statistical analysis revealed that there were no significant differences between stress inoculation training and stress education at post-treatment. Further, it was shown that both stress inoculation and stress education subjects showed significant reductions in plasma cortisol values from pre-to-post treatment assessment and a statistically insignificant reduction was reported in high fear no treatment control subjects.[191]

Carrillo-Diaz et al in a cross sectional descriptive study explored the relationships between frequency of dental visits, experience with treatments (fillings and extractions), and dental fear in sample of 147 children.[192] Girls reported a higher level of DA than boys, with these differences being statistically significant ($t = 3.23$, $df = 138.40$, $P < 0.01$). Further, girls and boys differed in their assessments on the aversiveness of

negative dental events ($t = 2.20$, $df = 145$, $P < 0.05$), with girls having a higher tendency to catastrophise. Children's mean values for dental fear ($F = 6.03$, $P < 0.01$) and expectations on the likelihood of negative dental events ($F = 9.05$, $P < 0.01$) differed significantly on the basis of their frequency of visits to the dentist. Post-hoc test data revealed that children in the group of less frequent attendees exhibited higher dental fear and perceived a higher likelihood for the occurrence of negative dental events than those children who visited their dentist every 6 months.[192]

Davies et al audited the records of a group of 60 patients who had previously benefited from CBT for dental phobia.[193] Twenty out of 30 patients who were offered CBT were subsequently able to have dental treatment without IV sedation and in a 10 year follow-up study, the electronic records of 19 of the 20 patients who had originally been successful with CBT were re-audited. The results showed that of the 19 successful CBT patients available to follow-up, 100% had not received IV sedation since the study ten years ago, which suggested that the initial benefit of CBT was sustained over the ten-year period. Overall, the results suggested that CBT proved beneficial for patients with dental phobia during the initial treatment and over a 10 year period.[193]

de Jongh et al investigated the effectiveness of a single session of cognitive restructuring in a group of 52 dental phobic patients who were randomly assigned to one of the three study groups: cognitive restructuring (modification of negative cognitions), provision of information (about oral health and dental treatment), and a wait list control condition.[194] The two intervention groups showed significant decline in dental trait anxiety in comparison with the waiting list control condition. Further, the analysis at a follow-up of one year showed a significant reduction in DA in both the intervention groups. In addition, the cognitive intervention condition showed a decline in dental trait anxiety. Analysis of one month follow-up data in regards to DAS revealed that the cognitive intervention was still effective: DAS scores in the cognitive intervention ($M = 14.7$; $SD = 2.8$) were significantly [$F(I,18) = 7.8$, $p < 0.05$] lower than in the other intervention ($M = 17.8$; $SD = 1.9$).[194]

Dumitrache et al in a RCT investigated the effectiveness of cognitive technique in reducing DA in 40 dental phobic patients (MDAS > 13) of a dental clinic in Bucharest.[195] The results showed that the cognitive technique significantly decreased the anxiety levels following the intervention (Table 57). Further, the differences between

mean anxiety values, as measured by global DFS score, for the interventional group, showed a statistically significant difference (t=25.637, p=0.000).[195]

Table 57 DFS scores and results of T test

DFS score	**Cognitive intervention group (N =20)**	**Control group (N =20)**	**T Independent test**	
	Median ± SD	Median ± SD	Group	t & p value
Global score				
Before intervention	72.95 ± 4.006	65.60 ± 8.325	Intervention group	25.627 & 0.000
After intervention	57.90 ± 3.972	65.40 ± 8.325	Control group	1.710 & 0.104
Anticipation avoidance				
Before intervention	10.8 ± 1.57	9.60 ± 1.984	Intervention group	9.200 & 0.000
After intervention	8.59 ± 1.27	9.55 ± 1.959	Control group	1.000 & 0.330
Physiological anxiety				
Before intervention	18.55 ± 3.05	15.20 ± 2.16	Intervention group	14.371 & 0.000
After intervention	12.80 ± 2.62	15.20 ± 2.167	Control group	0 & 0.000
Anxiety to stimuli				
Before intervention	50.25 ± 3.05	41.85 ± 5.304	Intervention group	12.651 & 0.000
After intervention	36.8 ± 3.12	41.70 ± 5.352	Control group	1.831 & 0.083

Haukebø et al conducted a RCT involving 40 participants (aged between 18 and 65 years) with dental phobia (DSM-IV criteria) who were randomly assigned to a waitlist control group, and one-session or five-session exposure CBT treatment.[196] Results showed that at post-treatment, the five-session group scored lower on the DA scales; however, at follow-up, both the groups reported same levels of DA. The CBT exposure treatment had a significantly larger effect on the level of anxiety when compared to no treatment, and the immediate treatment group and the waitlist group experienced a significant reduction [$t(15) = 5.6$, $p=0.0001$ vs. $t(16) = 2.4$, $p<0.05$]. Further, the anxiety decreased significantly from pre- to post-treatment [$t(30) = 6.1$, $p=0.0001$], and also from post-treatment to follow-up [$t(24) = 2.8$, $p =0.01$] for the whole group. The immediate treatment group improved significantly on all three measures: DAS [$t(16) = 7.1$, $p<.0001$], DFS [$t(16) = 4.9$, $p<.0001$], and DBS-R [$t(17) = 2.4$, $p = .03$] in comparison to the waitlist group and in addition, the five-session treatment lead to greater reductions than the one-session group on all three measures at post-treatment, which however were not sustained at follow up.[196]

The one-session treatment showed significant reductions on DFS from pre- to posttreatment [t(19) = 3.7, p =0.002], and from post-treatment to follow-up [t(15) = 3.1, p = .007]. Scores on DAS were significantly reduced from pre- to post-treatment [t(19) = 7.0, p<.0001], and the reduction was maintained from post to follow-up. For DBS-R, there was a significant reduction from post-treatment to follow-up [t(14) = 3.8, p = .002]. The five-session group had significant reductions from pre- to post-treatment for: DFS [t(16) = 8.6, p<.0001], DAS [t(16) = 11.2, p<.0001], and DBS-R [t(15) = 3.9, p <.001], but not from post-treatment to follow-up (Table 58).[196]

Table 19 58 Means (SD) for self-report scales and maximum level of anxiety

Variable	**Original groups**			**With waitlist included**		
	Treatment	**Waitlist**	**F-ratio (df)**	**One-session**	**Five-session**	**F-ratio (df)**
Maximum anxiety						
Pre	8.8 (1.5)	8.7 (1.3)	G: 7.1 (1, 31)	8.5 (1.1)	8.4 (1.6)	G: 2.2 (1, 21)
Post	4.8 (2.4)	7.7 (2.5)	T: 35.9**** (1, 31)	6.0 (2.5)	4.4 (2.9)	T: 54.3**** (2, 42)
1 year				4.4 (2.6)	2.8 (2.3)	I: 1.7 (2, 42)
Dental Fear Survey						
Pre	78.6 (7.7)	75.6 (8.9)	G: 7.6** (1, 34)	75.2 (8.5)	76.8 (10.1)	G: 5.9* (1, 28)
Post	58.4 (14.1)	75.7 (8.8)	T: 22.1**** (1, 34)	64.3 (9.6)	45.0 (9.5)	T: 69.4**** (2, 56)
1 year			I: 22.6**** (1, 34)	52.2 (15.3)	48.1 (12.9)	I: 12.8**** (2, 56)
Dental Anxiety Scale						
Pre	17.2 (2.2)	17.00 (2.8)	G: 10.3** (1, 35)	16.6 (2.0)	16.6 (2.8)	G: 1.3 (1, 28)
Post	11.5 (3.0)	16.6 (2.8)	T: 40.2**** (1, 35)	12.1 (3.0)	9.4 (2.2)	T: 101.5**** (2, 56)
1 year			I: 30.4**** (1, 35)	10.4 (3.4)	10.1 (3.2)	I: 5.0* (2, 56)
Dental Belief Scale-R						
Pre	86.8 (21.7)	89.5 (17.6)	G: 2.6 (1, 34)	88.4 (19.1)	88.7 (22.6)	G: 1.6 (1, 25)
Post	72.3 (24.5)	90.6 (24.4)	T: 3.4 (1, 34)	80.1 (16.4)	59.4 (20.8)	T: 15.3**** (2, 50)
1 year			I: 4.5* (1, 34)	62.7 (18.8)	61.3 (20.6)	I: 4.7* (2, 50)

G = group; T = time; I = interaction effect. *p<0.05;**p<0.01;***p<0.001;****p<0.0001

In addition, clinically significant improvement was calculated for maximum anxiety and DAS, which showed that there was a significant improvement for both treatment groups (Table 59).[196]

Table 59 Percentage of patients in each condition that achieved clinically significant improvement at post-treatment and at 1-year follow-up

Measure	RCI	Cut-off	Post		Follow up	
			One-session (N = 20)	Five-session (N = 19)	One-session (N = 19)	Five-session (N = 16)
Max anxiety	2	6	55	78.9	75	93.3
DAS	2	12	55	94.7	75	86.7

Kebriaee et al compared the effectiveness of CBT with inhalation sedation with nitrous oxide/oxygen (N2O/O2) in reducing dental anxiety in preschool children in a RCT, in which 45 preschool children with moderate to severe DA were randomly assigned to one of the groups: control group, N2O/O2 and CBT. [197] In the control group, BMTs were used, in group 2, nitrous oxide/oxygen gas was used and in group 3, unrelated play, Benson's breathing and positive self-talk and modelling were used. Results showed that treatment with CBT significantly reduced DA and increased cooperation in the second visit compared to the control; however, there were no significant differences between the two intervention groups. The CFSS-DS, Venham clinical anxiety scale (VCAS) and VPT scores for CBT, nitrous oxide sedation and control group were: CFSS-DS 41.86 ± 5.58, 40.00 ± 3.96, 43.00 ± 5.11; VCAS - 26.77, 22.73, 19.50; VPT - 4.93 ± 1.39, 4.67 ± 1.72, 4.71 ± 2.13, respectively. Cognitive behaviour therapy may be more beneficial than using nitrous oxide sedation considering the adverse effects and necessity of equipment and trained personnel to use nitrous oxide and oxygen inhalation sedation.[197]

Spindler et al conducted a study to examine the effect of a brief CBT intervention for patients with dental fear who were randomly assigned to either an immediate intervention or a waiting list group, wherein both the groups received an identical intervention, but was delayed by 4-6 weeks in the waiting list group.[201] Statistical analysis showed that there was a significant reduction in dental fear in the immediate intervention group (d=1.5-2.2) when compared to the waiting list group (d=0.3-0.4) (Table 60). Further, all participants showed a significant reduction of dental fear following the brief intervention, and in a small subgroup, this effect was maintained at 2 years as well.[201]

Table 60 Pre-, Post-Intervention, and 2-Year Follow-Up Scores* on the DAS and the DFS

	Immediate intervention			Waiting list		
	Pre-intervention Mean (SD) (n=52)	Post-intervention Mean (SD) (n=34)	Two-year follow-up Mean (SD) (n=25)	Pre-intervention Mean (SD) (n=50)	Post-intervention Mean (SD) (n=25)	Two-year follow-up Mean (SD) (n=19)
Dental Anxiety Scale (DAS)	16.0 (3.0)	9.7 (2.9)	10.3 (3.5)	16.6 (2.6)	10.2 (2.8)	9.9 (3.0)
Dental Fear Survey (DFS)	70.1 (13.4)	49.6 (13.5)	52.1 (17.7)	72.0 (13.4)	46.8 (13.0)	46.2 (11.4)

Treiber et al evaluated the effectiveness of a coping skills training procedure in a small group of 10 preschool children receiving topical anaesthetic and LA followed by either an extraction or one or more amalgam restorations.[(202)] Behavioural modified behavioural profile rating scale (MBPRS), VPT and heart rate measures were obtained. Results showed that the groups did not differ on a self-report measure of anxiety nor on heart rate during dental treatment (Table 61). There was a tendency towards significance with decreased anxiety levels in the coping skills training group; however, in the control group children tended to be more anxious after dental treatment than before.[(202)]

Table 61 Mean and SD values of behavioural, self-report and physiological measures

Variable	Coping skills group	Control group
MBPRS total score	1.85 ± 1.61	3.56 ± 3.18
VPT predental treatment	2.50 ± 2.00	1.40 ± 1.95
VPT postdental treatment	1.88 ± 1.55	2.20 ± 3.19
Heart rate	100.29 ± 8.83	110.49 ± 11.95

Vika et al conducted a study to evaluate the effect of one and five sessions of treatment for intra-oral injection phobia in 55 subjects (aged from 18 to 65 years, DSM-IV criteria).[(203)] The DAS, the injection phobia scale-anxiety measurements were applied. In terms of dental attendance, 49 (89.1%) of the 55 patients had received an intra-oral injection during the follow-up year: 23 (82.1%) from the one-session group and 26 (96.3%) from the five-session group; however, the difference was not statistically significant. There was a significant improvement in both the groups from pre-treatment to post-treatment, the effects of which were maintained at 1-yr of follow-up (Tables 62 and 63).[(203)]

Table 62 Mean values SD for maximum anxiety during the behavioural test at pre-treatment, post-treatment, and 1-yr follow-up time-points

	One-session		Five-sessions		95% CI
	n	Mean ± SD	n	Mean ± SD	
Pretreatment	28	68.9 ± 23.8	27	65.0 ± 26.7	-9.8 to 17.5
Posttreatment	28	44.2 ± 25.6	26	28.3 ± 23.4	2.0 to 29.9
1-yr follow-up	21	37.1 ± 28.6	24	25.4 ± 23.3	-3.9 to 27.3

Table 63 Mean and SD values for dental anxiety scale (DAS) at pre-treatment, post-treatment, and 1 yr of follow-up time-points

	One-session		Five-sessions		95% CI
	n	Mean ± SD	n	Mean ± SD	
DAS					
Pretreatment	28	15.9 ± 3.1	27	14.9 ± 2.9	-6.1 to 2.6
Posttreatment	28	11.1 ± 3.3	26	8.8 ± 2.2	0.9 to 3.9
1-yr follow-up	25	11.9 ± 4.0	24	8.2 ± 2.4	1.8 to 5.6

Case reports

Lisowska & Zoitopoulos described a case of severe needle phobia in a 13-year-old girl and explored several anxiety management techniques to overcome this condition.[198] The program involved establishing the problem, identifying the effect on the patient and rectifying the problem, which led to CBT that proved beneficial in overcoming the needle phobia. Throughout the treatment program, the patient's fears about pain associated with injections were soothed leading to anxiety reduction and the patient was able to have the injection for dental treatment. However, the procedure was expensive mainly due to the time involved in securing a successful outcome but this was off-set by the use of the external resource of the anxiety management team and avoiding the use GA with its associated risks and costs.[198]

Mansell and Morris described a case of a 14 year old adolescent boy with multiple phobias who was treated successfully for his dental phobia through the clinical utility of the Dental Cognitions Questionnaire (DCQ) in aiding effective CBT.[199] The treatment involved: imaginal and in vivo exposure under the client's control; timeline construction of the onset and progression of the dental phobia and other fears; psychoeducation on the anxiety response; information about the dental procedure; identification and restructuring of cognitions using the DCQ; and brief relaxation techniques. The outcome was assessed by change on the MDAS and it was shown that there was a reduction in DA level with the use of the DCQ. The patient who had severe dental phobia (MDAS

score of 25) before the start of the treatment showed a greater reduction in DA (MDAS score of 10) following completion of the treatment, which was maintained at 1-, 6- and 18-month follow-up.[199]

Wilson and Davis described a case of a 41-year-old male patient who was referred to the specialist psychotherapy services for CBT, and received a 1 hour course of therapy.[204] Following treatment with CBT, on subsequent visits the patients successfully had LA, and underwent dental treatment that involved three fillings, scaling and polishing. The patient's phobia reduced and was able to return to general dental practice, after the brief therapeutic CBT intervention, and subsequent dental treatment.[204]

Qualitative study

Shahnavaz et al conducted a qualitative study to explore the views and experiences of children with DA and their parents with CBT in dentistry.[200] The authors interviewed 12 children and one of their parents and conducted a thematic analysis of the transcribed interviews. Three main themes emerged from the analysis: mastery, safety, and reduced fear. There were also six subthemes that were identified from the analysis, which included: gradual exposure; autonomy and control; therapeutic alliance; changed appraisal; reduced anticipatory anxiety and coping. The results from this qualitative study showed that parents and children had positive experiences of CBT and its outcome and overall, were able to benefit from this treatment in terms of overcoming and managing their DA and dental fear.[200]

Table 64 Assessment of methodological quality (Cognitive behaviour therapy (CBT))

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Akins et al 1982	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Berge 2016	RCT	U	N	Y	Y	N	Y	Y	Y	Y	Y	I	7
Bosmajian 1981	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Carrillo-Diaz et al 2012	Descriptive study	N	Y	Y	Y	N	Y	N	Y	Y		I	6
Davies et al 2011	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
De Jongh et al 1995	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Dumitrache et al 2014	RCT	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Haukebø et al 2008	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Johren et al 2007	Quasi-experimental	N	N	N	Y	N	N	Y	Y	U	Y	E	4
Kani et al 2015	Descriptive study	N	Y	N	Y	U	N	N	Y	U		E	3
Kebriaee et al 2015 1986	RCT	Y	N	Y	N	N	Y	Y	Y	Y	Y	I	7
Lisowska & Zoitopoulos 2009	Case report	Y	Y	Y	N	N	U	N	Y	Y	N	I	5
Mansell & Morris 2003	Case report	Y	Y	U	N	Y	Y	U	Y	Y	N	I	6
Moore 2000	RCT	Y	N	N	N	N	U	Y	Y	N	Y	E	4
Moses & Hollandsworth 1985	RCT	U	N	N	N	N	U	Y	Y	Y	Y	E	4
Nelson 1981	Case report	Y	U	Y	N	N	N	N	U	U	N	E	2
Nocella & Kaplan 1982	RCT	U	N	N	N	Y	U	U	U	U	U	E	1
Oakley et al 1994	RCT	N	N	N	N	N	U	U	Y	Y	U	E	2

Potter et al 2016	Descriptive study	U	N	N/A	Y	N/A	Y	N/A	Y	U		E	3
Shahnavaz et al 2015	Qualitative study	U	Y	Y	Y	Y	Y	N	Y	Y	Y	I	8
Smyth 1999	Case report	Y	Y	Y	U	N	N	N	U	U	N	E	3
Spindler et al 2015	RCT	U	N	Y	Y	N	Y	Y	Y	Y	Y	I	7
Steblay & Beaman 1982	RCT	U	N	N	N	N	U	Y	U	U	U	E	1
Treiber et al 1985	RCT	U	N	N	N	Y	Y	Y	Y	Y	Y	I	6
Vika et al 2009	RCT	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	I	9
Wilson & Davies 2001	Case report	Y	Y	Y	U	N	N	N	Y	Y	N	I	5

4.4.7. Communication/Information/Education

Sixteen studies (13 RCTs, one block RCT and two quasi-experimental studies) were included in the review that examined interventions related to the modalities of using effective communication and providing information and education.[205-220]

Babu et al in a RCT assessed the role of preparatory information on children's anxiety levels before and after dental treatment procedures in a sample of 60 children.[205] In the intervention group, each child was explained about the dental procedure and the dental procedure was then carried on the child. In the control group, children were not explained about the procedure and the dental treatment was carried out. Results showed that the reduction in anxiety levels were not statistically different between the groups. In a RCT involving 119 patients, that tested the hypothesis that informing dentists about patients' dental anxiety prior to commencement of treatment reduces patients' state anxiety, it was found that patients in the intervention group showed a greater reduction in mean change STAI-S scores ($F[1,119] = 8.74$, $P < 0.0001$) when compared to the control group where dentists were not informed.[206]

In a RCT conducted by Dailey et al[206] in 2002, it was hypothesised that informing dentists about patients' DA prior to commencement of treatment reduces patients' state anxiety. The trial involved eight General Dental Practitioners in North Wales who treated 119 patients attending their first session of dental treatment, and with high DA (score ≥19, or a score of 5 on any one question, of the MDAS). Patients were randomly allocated to an intervention group (dentist informed of MDAS score) and a control (dentist not informed) group. Results indicated that the patients in the intervention group reported greater reduction in mean change STAI-S scores ($F[1,119] = 8.74$, $p<0.0001$) (Table 65).

Table 65 Change in Spielberger state anxiety inventory scores (STAI-S) between baseline and post-treatment for intervention and control groups

	Change in State Anxiety Scores			
	Mean	SE (standard error)	CI 95%	n
Intervention group	4.1	0.54	3.1-5.1	60
Control group	1.9	0.49	0.8-3.0	59

Folayan et al conducted a quasi-experimental study to examine the effect of information received about dental care on the anxiety level of the child prior to receiving any form of dental treatment and on their behaviour during dental treatment.[207] Eighty-four healthy child patients, aged between 8 and 13 years were asked to identify their source and type of dental information received, which was later categorised into positive or negative. The mean dental anxiety scores showed that previously received information did not appear to have any significant impact on the DA level of these children. Gazal et al evaluated the value of using the visual information for reducing the level of dental fear and anxiety in 64 patients undergoing teeth extraction under LA.[208] In the intervention group, tooth extraction video was showed and in the control group only verbal information and routine warnings were provided. There was a significant difference ($p< 0.05$) among the mean dental fear and anxiety scores between the groups post-extraction, where patients in the intervention group were more comfortable after dental extraction than the control group. Significant reductions in dental distress and anxiety scores between the pre-operative and either post video information scores or postoperative scores ($p< 0.05$) were reported in the intervention group. In addition, it was found that younger patients reported higher dental fear and anxiety scores than older ones ($p<0.05$).[208]

Hally conducted a mixed methods study to evaluate the effectiveness of effective verbal and non-verbal communication (VNVC) to reduce dental state anxiety in six NHS Highland Salaried Dental Practices, which were randomised to start either with the experimental group, where dentally anxious patients (MDAS score ≥ 19 or 5 in any one question) complete and handover MDAS to the dentist, or the control group where no handover occurred.[209] Following on from the experimental study, an observational study was conducted where all the participants had their dental treatment appointment videoed. Overall, 54 patients took part in the study with 47 completing at 3-month follow-up. The experimental study found no difference in state or trait DA; however, observational outcomes showed dental state anxiety remained high when handover was not carried out. There was a significant reduction in dental trait anxiety when dentists blocked patient expressed cues and concerns; ($F[155.06]=7.51$, $p=0.009$).[209]

Hull & Humphris conducted a RCT to compare the degree of anxiety reduction in dentally anxious patients attending a Dental Access Centre where the dentist did or did not receive the patients' assessment of dental anxiety.[210] Patients were randomised into

three groups: group 1 were controls, group 2 gave their MDAS to the receptionist who passed it onto the dentist unknown to the patient and group 3 handed their MDAS to the dentist. Results showed that patients in group 3 were reported to be less anxious (by more than STAI-S 3 scale units) on leaving the dental surgery compared to those from the other groups especially if they had a discussion with the dentist about their concerns (by more than 5 scale units).[210] Jackson & Lindsay conducted a quasi-experimental study including 50 patients who had read one of two different leaflets in the waiting room.[211] One informative leaflet included information about pain control and stop signals and another leaflet did not include this information and both leaflets were designed, according to published evidence and in an appropriate format. Results showed that State Anxiety decreased significantly only in the patients who read the informative leaflet ($p<0.01$) and these patients rated it as much more helpful than those given the comparison leaflet ($p=0.007$).[211]

Jones conducted a RCT of a computer version of a children's patient request form developed specifically for dental visits (the SAID, survey of anxiety and information for dentists, a questionnaire with three embedded subscales: dental anxiety, coping style and dental neglect) to assess it as an intervention for reducing dental anxiety in a sample of 168 children, aged between 10-13 years.[212] The intervention group completed the e-SAID, in which the first and last questions measured anxiety; and printed a summary of their responses for the dentist and the children in the control group completed the same anxiety questions, but with a time-lapse. The intervention group mean anxiety score decreased following completion of the e-SAID, while the control group mean anxiety score increased with a small significant interaction effect; however, much of the change occurred in the positive-affect end of the scale.[212]

Kazancioglu et al[213] in 2015 assessed the effects of watching live taping (a video) of third molar removal on patients' anxiety levels before and after tooth extraction in a RCT including 333 patients who were randomised into three groups: two study groups (for group 1, basic information was given verbally; for group 2, which was the study group, basic information was given verbally and through a movie on third molar extraction); and a control group (basic information was given verbally; it did not include information on operative procedures and recovery). Anxiety levels were assessed using the DAS and the Spielberger STAI and pain was assessed with a VAS. Results showed that group 2 patients were significantly more anxious before the surgical procedure, and the most

significant decreases in DAS and STAI scores were observed in that group (Table 66). Additional data showed that age, surgery time, and education level did not correlate with anxiety or pain levels.

Table 66 Mean anxiety questionnaires scores at various time points

	Preoperative Mean ± SD	**Immediately postoperative Mean ± SD**	**One week later Mean ± SD**	**P value**
Group 1				
Corah DAS	9.21 ± 2.02	5.03 ± 1.05	7.01 ±1.04	0.26
STAI-S	30.01 ± 22.45	24.12 ± 9.23	24.26 ± 12.34	0.06
STAI-T	41.03 ± 25.05	38.11 ± 15.04	37.23 ± 30.12	0.74
Group 2				
Corah DAS	16.11 ± 3.74	7.23 ± 3.07	9.46 ± 1.53	0.001
STAI-S	48.54 ± 34.41	22.29 ± 13.46	24.46 ± 22.04	0.001
STAI-T	42.13 ± 21.15	40.02 ± 30.34	42.45 ± 34.10	0.78
Control group				
Corah DAS	11.34 ± 2.43	6.30 ± 1.76	8.38 ± 3.67	0.04
STAI-S	33.54 ± 34.41	23.81 ± 23.33	28.02 ± 14.30	0.03
STAI-T	40.10 ± 11.94	36.16 ± 14.70	35.67 ± 10.03	0.71

Ng et al analysed the effectiveness of pre-operative information provision for anxiety reduction during dentoalveolar surgery in patients with high- or low-trait anxiety who were randomly assigned to four groups: (i) basic information only, (ii) basic information with details of the operative procedures, (iii) basic information with details of the expected recovery, and (iv) basic information with details of both the operative procedures and recovery.[214] Self-rated anxiety was recorded immediately before, during and 10 min after the surgical procedures. It was reported that pre-operative provision of details about the expected recovery only or details concerning both the operative procedures and recovery led to significant decrease in self-reported anxiety among the participants throughout the procedure ($p<0.01$). Information on operative procedures showed anxiety reduction in low ($P < 0.05$) but not high-trait anxiety participants.[214]

In a study by Olumide et al that examined whether viewing a leaflet explaining the benefits of dental treatment would have a significant impact on children's anticipatory anxiety, it was reported that there was no statistically significant effect of the

experimental leaflet on self-reported anxiety levels, although anxiety levels showed a slight reduction in both groups after reading a leaflet.[215] Fifty children aged between 8-12 years were included in the study who were randomly allocated to either an experimental group (intervention leaflet containing child-friendly dental information or a leaflet) or the control group (child-friendly information on the benefits of healthy eating). Tanidir et al conducted a study to find out the ideal information required by the patient before extraction of an impacted wisdom tooth in a sample of 129 patients who were randomly allocated into three groups: control group; video dubbed by the surgeon; and silent video.[216] Results showed that there were no significant differences in anxiety scores among the different outcome measurement scales before and after operation and the anxiety levels were similar throughout the study in all groups. However, it was reported that patients were more satisfied with the information when they had seen it on video, and preferred to be told about further procedures in the same way.[216]

van Wijk & Hoogstraten in 2006 conducted a study to evaluate the provision of positive information about endodontic treatment to reduce fear of pain associated with the treatment in a large sample (n = 437) of patients who were randomly allocated to read one of five informative paragraphs.[219] The paragraphs consisted of dental information obtained from patient brochures and one experimental paragraph consisted of positive information about pain during endodontic treatment. It was found that patients who were given the positive information regarding the treatment reported less fear of pain.[219] In a RCT by van Wijk and Lindeboom, the effect of a separate consultation with an oral and maxillofacial surgeon on levels of anxiety before third molar extraction was evaluated, wherein patients were randomly allocated to either the experimental (received standard information about third molar extraction in a separate consultation visit before the surgical procedure) or the control group (received the same information just before and at the same visit as the surgical third molar removal).[217] There were no statistically significant differences on the measures of anxiety between the groups; however, patients appreciated the fact that they had a separate consultation.

van Wijk et al evaluated the impact of high versus low information provision on anxiety during third molar tooth extraction, in addition to evaluating satisfaction with information provision.[218] Participants (n=320, aged between 16-51 years) were randomly allocated into two groups and asked to read either high or low information concerning third molar extraction. Results showed that there was a beneficial effect in

the information group. The high information text was found to be more informative and more satisfactory by all the participants.[218]

Wright et al evaluated the effect of supplementation of verbal information with written information when obtaining consent to orthodontic treatment on anxiety, motivation and apprehension related to treatment in 76 adolescents who were randomly allocated to receive verbal information only or verbal and written information before orthodontic treatment.[220] Participants' anxiety, motivation, and apprehension were assessed using a questionnaire at three stages; prior to meeting the orthodontic clinician (T1), following consent to treatment (T2), and after 12 weeks of treatment (T3). Data analysis revealed that at T2 there was no change in anxiety scores for either group ($p=0.412$) and at T3 both groups demonstrated similar reductions in anxiety ($p=0.311$) and apprehension ($p=0.790$). However, non-significant reductions in periodontal scores ($p=0.065$), better appointment attendance ($p=0.732$), and fewer breakages ($p=0.525$) were reported in the group that was given additional information.[220]

Table 67 Assessment of methodological quality (Communication/Information/Education)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Babu & Jha 2015	RCT	Y	N	N	N/A	N	Y	Y	Y	Y	Y	I	6
Birch 2003	Descriptive	Y	N	N	U	U	N	N	U	U		E	2
Carlsen et al 1993	RCT	U	N	N	N	N	U	Y	Y	U	Y	E	3
Casap et al 2008	RCT	N	Y	N	N/A	N	U	Y	Y	Y	Y	E	4
Dailey et al 2002	RCT	Y	N	Y	N	U	Y	Y	Y	Y	Y	I	7
Folayan & Idehen 2004	Quasi-experimental study	N	N	N	N	N	U	Y	Y	Y	Y	I	4
Gazal et al 2016	RCT	U	U	Y	N	U	U	Y	Y	Y	Y	I	5
Griffiths et al 1998	RCT	U	U	U	N	U	Y	Y	Y	Y	U	E	4
Hally 2011	RCT	Y	Y	U	Y	U	Y	Y	Y	Y	Y	I	8
Herbertt & Innes 1979	RCT	U	N	N	N	N	U	Y	Y	Y	U	E	3
Hoogstraten & Moltzer 1983	RCT	U	N	N	N	N	U	Y	U	U	U	E	2
Hull & Humphris 2010	RCT	Y	Y	Y	N	U	Y	Y	Y	Y	Y	I	8
Jackson & Lindsay 1995	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Jones 2015	RCT	Y	Y	Y	N	N	U	Y	Y	Y	U	I	6
Kazancioglu et al 2015	RCT	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	I	9
Kupietzky 2006	RCT	N	N	N	N	N	U	Y	Y	Y	U	E	4
Manani et al 2010	Quasi-experimental	N	N	N	N	N	U	Y	Y	Y	U	E	3

Moltzer & Hoogstraten 1986	RCT	U	N	N	N	N	U	U	Y	U	U	E	0
Ng et al 2004	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Olumide et al 2009	RCT	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	I	9
Sarnat et al 2001	Quasi-experimental	N	N	N	N	N	U	Y	Y	Y	U	E	3
Soh 1992	Quasi-experimental	N	N	N	N	N	U	Y	Y	Y	U	E	3
Tanidir et al 2016	RCT	U	N	Y	N	N	Y	Y	Y	Y	Y	I	6
van Wijk & Hoogstraten 2006	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
van Wijk & Lindeboom 2008	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
van Wijk et al 2010	RCT	Y	N	N	N	N	Y	Y	Y	N	Y	I	5
Wright et al 2010	RCT	Y	Y	N	N	N	Y	Y	Y	Y	Y	I	7

4.4.8. Dental Office Environment and Waiting Rooms

One study was included in the review that was relevant to the design of the dental office and the dental office environment.[29]

Shapiro et al conducted a crossover RCT to assess the efficacy of a Snoezelen sensory adapted dental environment (SDE) in reducing anxiety among 19 children (aged between 6-11 years) undergoing scaling and polishing by a dental hygienist.[29] The SDE involved a partially dimmed room with lighting effects, vibroacoustic stimuli, and deep pressure. Overall, results showed that both behavioural and psychophysiological measures of relaxation improved significantly in the SDE when compared to a regular dental environment. The treatment effect was found to be significant (p=0.007, 0.009), for both the mean duration and the magnitude of anxious behaviours in the SDE group when compared to those in the regular dental environment group. In addition, it was found that the children in the SDE group showed significantly improved cooperation compared to those in the regular dental environment group (Table 68).

Table 68 Comparison of anxious behaviours of children treated in a sensory adapted dental environment (SDE) vs. a regular dental environment (RDE), Mean ((95% CI) ± SD)

Name of measure	SDE	RDE	SDE-RDE (Paired difference, 95% CI)
Duration of accumulative anxious behaviours (in minutes)	1.48 (-2.21; 5.18) ± 1.76	3.7 (-1.7; 9.1) ±3.72	-2.22* (-3.76; -6.75)
Magnitude of anxious behaviours (five-point Likert scale)	1.84 (-0.22; 3.91) ± 1.12	3.63 (0.88; 6.38) ±3.18	-1.79* (-3.07; -0.51)
Cooperation as measured by the dental hygienist	4.95 (4.84; 5.06) ± 0.23	4.42 (4.09; 4.75) ±.69	0.53* (0.19;0.86)

*P < 0.01

Table 69 Assessment of methodological quality (Dental Office Environment and Waiting Rooms)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Panda et al 2014	Cross-sectional	N	Y	N	N	N/A	N	N/A	U	Y		E	2
Shapiro et al 2007	Crossover RCT	U	N	N	N/A	N	Y	Y	Y	Y	Y	I	5

4.4.9. Dentist-Patient Relationship

Five studies (one RCT, three qualitative studies and one cross sectional study) were included in the review that examined dentists-patient relationships and their effect on DA.[221-225]

Greenbaum et al investigated the effectiveness of reassuring touch to reduce children's anxiety and improve their behavior during a routine pediatric dental examination.[223] Thirty-eight children, aged between 3.5 and 10 years were randomly assigned to two groups, where in the experimental group (touch), children were patted on the upper arm or shoulder on two separate occasions by the dentist during the examination while simultaneously receiving verbal reassurance and descriptions of the upcoming procedures and in the control group (no-touch), children received only the reassuring verbal descriptions without contact. Results showed that children in the intervention group between the ages of 7 and 10 years (but not children aged 3.5 to 7 years) displayed less uncooperative behavior when compared to the control group ($P < 0.05$). In addition, children in the intervention group reported greater pleasure ($P < 0.06$) and less dominance ($P < 0.10$) than children in the control group.[223]

Folayan et al conducted an analytical cross-sectional study to investigate effects and interrelationship between dental anxiety and dentist's experience, dentist's behaviour, the type of dental anxiety treatment received and the behaviour of Nigerian children during treatment.[222] Analysis revealed that the anxiety level of the children decreased significantly post-treatment when experienced dentists managed the child in comparison to inexperienced dentists ($Z=3.22$, $p<0.02$). The dentist's behaviour did not significantly affect the anxiety level of the child, and the more invasive the procedure, the less the tendency for a decrease in anxiety level of a child post-treatment, which was statistically non-significant ($z=1.34$; $p<0.44$).[222]

Qualitative studies

Abbe et al described comforting strategies that were performed by dentists, dental assistants, and hygienists for their patient population.[221] Overall, 3,800 patient interactions with dentists and hygienists were observed and recorded. The qualitative

data revealed some themes that revealed the various comforting strategies employed by dentists in reducing their patients' anxiety. Some of the themes included: environmental distractions, alleviating physical discomfort, visual and verbal monitoring and structuring the interaction. Provision of environmental distractions through the use of massage pads, flat screen televisions, music and individual headphones was seen a means of making patients comfortable as one patient said: "…the doctor used to have a mural of a big tree and I used to love looking at it while getting teeth fixed ….". Alleviation of physical discomfort was perceived as an important strategy for minimising DA; for example, using a topical gel prior to administering LA and dentists stopping the procedure when their patients indicated pain. Visual and verbal monitoring involved 'checking-in and noticing' that included asking patients throughout the procedure on how they were doing. And noticing patient discomfort through their body language. Structuring the interaction involved taking the time to explain the procedure to the patient and clarify what patients should expect.[221]

Kulich et al conducted a grounded theory study involving 30 semi-structured interviews with 5 dentists (3 male and 2 female) following first and second consultations with 15 newly enrolled dental phobic patients (2 male and 13 female) in a clinic specialising in the treatment of odontophobia.[224] Five categories were grounded in the data: 1 core category: 'Relatedness, based on affective resonance and concordant roles' and 4 additional higher-order categories: 'the dental phobic patient's emotions'; 'the patient's verbal and non-verbal cues'; 'the dentist's role as a clinician: professional interpersonal skills'; and 'the dentist's role as a fellow-being: general interpersonal skills'. Kulich et al conducted another qualitative study with the same sample to explore a systematic theory of dentist-patient communication and new methods analysing how dentists interact with their patients.[225] The authors reported the following categories based on the analysis: "holistic perception and understanding of the patient", "the dentist's positive outlook on people" and "the dentist's positive view of patient contact".

Table 70 Assessment of methodological quality (Dentist-Patient Relationship)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Abbe et al 2007	Qualitative study	Y	Y	Y	Y	Y	N	U	Y	N	Y	I	7
Bass 1974	Case report	Y	U	U	U	N	N	N	U	Y	N	E	2
Corah et al 1988	Cross-sectional	U	Y	Y	U	N/A	N	N/A	Y	U		E	3
Folayan et al 2004	Cross-sectional	U	Y	U	Y	Y	N	N/A	Y	Y		I	5
Greenbaum et al 1993	RCT	Y	N	N	N/A	Y	Y	Y	Y	Y	Y	I	7
Kulich et al 2000	Qualitative study	Y	Y	Y	Y	Y	U	U	Y	Y	Y	I	8
Kulich et al 2003	Qualitative study	Y	Y	Y	Y	Y	U	U	Y	Y	Y	I	8
Weinstein et al 1992	Cross-sectional	Y	Y	U	U	U	N	N/A	U	Y		E	3

4.4.10. Equipment/Technique/Technology/Web

Twenty-three studies (11 RCTs, one crossover RCT, one block RCT, one split-mouth RCT, four quasi-experimental studies, three qualitative studies, one cross-sectional study and one case report) were included in the review that examined interventions related to the use of equipment, devices, techniques, technology and web-based platforms.[226-248]

Equipment

Goodell et al conducted a study to compare a device (Wand Local Anaesthesia System) that controlled flow rate during injection through use of a foot pedal with a conventional atraumatic syringe injection (CASI) technique on change from preinjection to postinjection anxiety, the pain perception, procedure tolerance, and anxiety about future injections in 80 endodontic patients (aged between 19 and 55 years).[230] The patients receiving the CASI technique reported significantly less postinjection anxiety, significantly less pain of injection, and significantly more positive overall experience ratings than those receiving the Wand injection ($p<.05$). There was no significant difference between groups when comparing anticipated future anxiety over a repeat dental injection of the same type. Both treatment groups reported significantly lower intragroup postinjection anxiety compared with preinjection levels for each question asked (Table 71). A conventional atraumatic syringe injection technique was found to be superior to a controlled injection pressure system in pain perception and procedure tolerance and in reducing postinjection DA.[230]

Table 71 Preinjection and postinjection intragroup anxiety scores for individual survey questions (Mean and SD)

Survey question	Preinjection Wand anxiety	Postinjection Wand anxiety	Preinjection conventional anxiety	Postinjection conventional anxiety
Question No. 1	1.03 (0.89)	.68* (.76)	.60 (0.81)	.25* (.54)
Question No. 2	1.20 (0.99)	.65* (.74)	.75 (0.90)	.35* (.62)
Question No. 3	1.60 (1.15)	.80* (.99)	1.30 (0.94)	.83* (.78)
Question No. 4	1.55 (1.09)	1.33* (.99)	1.48 (0.88)	.83* (.71)
Question No. 5	1.48 (0.91)	1.03* (.92)	1.43 (0.87)	.68* (.73)
Question No. 6	1.58 (1.11)	1.00* (.99)	1.40 (1.06)	.75* (.77)

*P < .05

Ksucu & Akyuz conducted a pilot study to assess how the physical appearance of dental injectors influenced children's choice in 34 randomly selected children (aged between 7 and 11 years).[234] Dental injectors (Wand, Citoject, traditional metal injector (MI), and

plastic injector (PI)) were displayed on a tray and introduced to the children. The anxious children preferred the Wand with significantly higher ratings (Wand=84%; Citoject=8%; MI=8%; PI=0%). Of the 34 children tested, the mean CFSS-DS score was 33.9±11.2, and 12 children scored higher than this mean anxiety score. The mean scores were 1.08±1.3 for VAS and 0.29±0.1 for FIS, and 13 and 19 children, respectively, scored above these mean values (Cronbach alpha coefficients for CFSS-DS and VAS are 0.80 and 0.51, respectively). The first preferences of the anxious and the nonanxious group were significantly different (p=0.011) from each other. Most of the anxious children (84%) preferred the Wand, some of them chose Citoject (8%) and the MI (8%), but none of the anxious children preferred the PI (0%) (Table 72). Among the nonanxious children, the PI and the Wand were preferred by 48% and 38% of the children. The MI was the least preferred injector (3%) for both groups.[234]

Table 72 The Relationship between First Preferred Injector and Anxiety in percentages

First preferred injector	Nonanxious children	Anxious children	Total
Wand	38% (n=8)	84% (n=11)	56% (n=19)
Plastic injector	48% (n=10)	0% (n=0)	29% (n=10)
Metal injector	0% (n=0)	8% (n=1)	3% (n=10
Citoject	14% (n=3)	8% (n=1)	12% (n=4)

Morse & Chow evaluated the effects of a brain wave synchroniser on anxiety in patients undergoing root canal treatment. Thirty patients were allocated into three groups: a verbal method (routine calming words by dentist) plus brain wave synchroniser, verbal method plus brain wave synchroniser and alpha relaxation tape, and a control group with verbal method alone.[235] Outcomes were measured using galvanic skin resistance, PR, physical responses, and pre- and post-treatment questionnaires at various stages of the treatment: start; LA injection; rubber dam application; drilling; x-ray taking; instrumentation; obturation; and conclusion. It was found that there was a significant reduction in anxiety due to the endodontic treatment in the two experimental groups compared to the control group.[235]

Mosskull Hjertton & Bågesund evaluated and compared Er:YAG laser with high-speed bur on cavity preparation time, the pulse changes and the patient's subjective experience during removal of healthy tooth substance in 35 participants, aged between 14-18 years.[236] The mean pulse change during preparation differed ($p < 0.05$) between the bur (+2.2%) and laser (−4.4%). It was further reported that patients experienced worse smell

with laser was used ($p < 0.01$) but 65.7% of the patients expressed less discomfort and 57.1% experienced a lower sound level with laser use. In addition, 62.9% of the adolescents preferred laser for future treatment.[236]

Queiroz et al evaluated anxiety state in 27 children (aged between 7 and 12 years) who underwent conventional and computerised dental anaesthesia.[237] Results showed that salivary cortisol levels increased in 8 (40%) patients after conventional anaesthesia and in 9 (45%) patients after computerised anaesthesia, which was not statistically significantly different between the two types ($p=0.34$).[237] Similarly, there was no statistically significant difference between the two techniques ($p=0.39$) in relation to the STAIC scores.

Restrepo et al evaluated the effectiveness of occlusal splints to reduce anxiety in a group of 36 bruxist children, aged between 3 and 6 years.[238] The children allocated to the experimental group used rigid bite plates for a two-year period, until mixed dentition and the children in this group did not show any statistically significant difference in anxiety levels when compared to the control group. There was a significant reduction in anxiety levels at the end of the study in both the groups (Table 73).[238]

Table 73 Comparison of anxiety levels before and after the intervention in the control and experimental groups and Anxiety levels after the treatment between the control and experimental groups

	Experimental			**Control**			
	Before	After	P value	Before	After	P value	
Anxiety levels before and after the intervention in the control and experimental group (at the end of the study)	0.80	0.40	0.001*	0.78	0.19	0.01*	
	Mean	SD		Mean	SD		P value
Anxiety levels after the treatment between the control and experimental groups	0.40	0.36		0.19	0.25		0.17**

Sarmadi et al conducted a study to explore experiences and perspectives after dental caries treatment with Er: YAG laser technology in 12 patients, aged between 15-30 years who had undergone at least one laser caries excavation.[239] All the interviews were tape recorded and transcribed, which were analysed using qualitative content analysis. Four

main categories were identified in this study that included: choosing laser, understanding laser, encouraging dental care and my oral health. Further, the subcategories included: initiative, dental fear as a motivating factor and experience of drilling as a motivating factor. Participants stated that their main motivation to undergo laser treatment was dental fear in general, and specifically fear of needles or discomfort with the drill. As one participant said "I had never had a filling before … they told me I had a cavity and I started thinking about drilling and all that. Then she mentioned that that maybe we could do it with laser. And what I thought was just that laser sounded good".[239]

In terms of patients' attitudes, patients who had undergone dental drilling previously reported a positive attitude to laser technology. In regards to dentists' views on laser treatment it was found that the clinicians considered the use of this technology beneficial, and therefore all aspects of the treatment were planned properly including the use of precise technique. Most of the patients' positive attitudes to laser treatment was due to the fact that this was a new technology.[239] As one patient said "I like new technology … I'm really in favour of new technology, they wouldn't have used laser unless it was better'. In addition, they felt safe with an ability to relax during the treatment. Another participant felt that the dental filling with laser was aesthetically very appealing compared to conventional drilling and filling, which was expressed as – "I was thinking, like, God how good, why how come I didn't know about this earlier … the next time if there is a next time it will definitely be laser. The results looked a lot better, it took no time at all, and I didn't feel a thing".[239]

Singh et al to evaluate a new communication device called 'Touch N' Tell' (based on perceived control) for management of anxiety in 60 dental patients (aged between 14 and 46 years) undergoing endodontic therapy, which was installed on the dental chair to help create an effective communiqué between the patient and dentist during the dental procedure.[240] Patients in the intervention group were treated along with the use of communication device installed on the dental chair, whereas the patients in the control group were managed in a routine manner. It was reported that there was a significant decrease ($p<0.001$) in the mean anxiety levels in the intervention group when compared to the control group (Table 74).[240]

Table 74 Means of pre-operative and post-operative scores of experimental group and control group during the study

Group	Preoperative	Postoperative	Mean change	t value & p value
Experimental	20.83	11.53	9.30	17.39 & <0.001
Control	20.46	18.20	2.26	

Tellez et al evaluated a computerised CBT intervention that was based on psychoeducation, exposure to feared dental procedures, and cognitive restructuring in 151 adult patients with high dental anxiety.[242] Patients were randomised into two groups: immediate treatment group or a wait-list control group. Results showed that there was a significant improvement in outcomes, and on further analyses, it was found that there were significant differences in dental anxiety, fear, avoidance, and overall severity of dental phobia in immediate treatment group compared to the control group at the follow-up assessment.[242]

Touyz et al[243] conducted in a split-mouth RCT in 2004 to assess the effects of a manual stimulating distraction device (Isoflex, MSDD) for reducing pain and anxiety experienced with standard dental LA injections in a sample of 100 patients. The procedure involved injecting LA solution on either the left or right side at different times by random selection; one side using MSDD, while the opposite side used a solution without MSDD. Overall, 46 patients used the MSDD first with the injection, while 54 used MSDD second when they received the injection. The VAS was used to assess pain and stress as reported by the patient each time after receiving the injection. Results showed that there were significant reductions in perceived pain and stress from LA injections ($p < 0.001$) when MSDD was used; however, there was no correlation of pain reduction with age, gender, upper or lower jaw, with or without MSDD (Table 75).

Table 75 Pain and anxiety scores

	Pain + No MSDD	Pain + MSDD	Anxiety + No MSDD	Anxiety + MSDD
Mean ± SD	5.29 ± 1.62	2.95 ± 0.91	5.81 ± 1.62	3.28 ± 1.16
Range	1-9	1-6	1.5-9	1-7

Ugurlu et al conducted a quasi-experimental study that compared an erbium-doped yttrium aluminum garnet (Er:YAG) laser evaluate with conventional instruments and

their effect on DA in 28 patients undergoing apicectomy procedures.[244] Results showed that there were non-statistical significant differences in state anxiety, trait anxiety, and postoperative questionnaire scores between the two groups, although the scores were lower in the intervention group (Table 76). Mean STAI-S and STAI-T scores were 46.29 ± 12.513 and 31.29 ± 12.513, respectively, for patients treated with an Er:YAG laser and 50.14 ± 16.16 and 35.14 ± 16.16, respectively, for patients treated with conventional instruments.[244]

Table 76 One Way ANOVA Statıstıcal Analysıs of STAI-State and STAI-Traıt

	Technique	Mean ± SD	Significance ($p < 0.05$)
STAI-state	Er: YAG	46.29 ± 12.513	0.627
	Conventional	50.14 ± 16.16	0.627
STAI-trait	Er: YAG	31.29 ± 12.513	0.627
	Conventional	35.14 ± 16.16	0.627

Ujaoney et al evaluated a novel Camouflage Syringe to reduce dental fear and anxiety in children in comparison to a conventional syringe.[245] The Camouflage Syringe was designed to appear like a toy, which masked the conventional syringe to enable topical application and LA administration. One hundred children, aged <15 years who were undergoing treatment for over-retained teeth, badly carious teeth or failed root canal therapies were allocated into the intervention group with the Camouflage syringe and a control group in which a conventional syringe was used. It was reported that there was a significant decrease in anxiety levels in the intervention group compared to the control group (Table 77).[245]

Table 77 Comparison of anxiety across trial arms - n (%)

	Camouflage syringe (n=50)	**Conventional syringe (n=50)**	**P value**
Child's dental behaviour and attitude			<0.0001
Enthusiastic	44 (88)	1 (2)	
Cooperative	6 (12)	7 (14)	
Anxious	0 (0)	10 (20)	

Versloot et al conducted a RCT to compare a computerised device (Wand) with a traditional syringe on pain and anxiety during two consecutive treatment sessions, In addition, the response to the two injection techniques was also evaluated in terms of their differences in high and low dentally anxious children.[246] Children in one group received two LA injections with the traditional syringe and the other group received two LA injections with the Wand. Based on the CFSS-DS scores, 147 children (aged 4-11 years)

were divided into highly and low dentally anxious groups. The outcome measurements suggested that during the LA injection there were no differences reported between the two groups over the two treatment sessions. However, it was found that highly anxious children reported more pain (p = 0.001), displayed more pain related behaviour (p = 0.002) and more distress (p <0.001) than low anxious children in response to the LA injection during the first treatment session.[246]

The mean CFSS-DS score for the total group was 30.33 (SD 11.24) and 38% (n = 53) of the children had a CFSS-DS score above 32. The mean CFSS-DS score for the highly anxious children (HAC) was 41.77 (SD 9.14) and the mean CFSS-DS score for the low anxious children (LAC) was 23.24 (SD 5.06). The results showed no main effect for the injection technique ($F(3,133) = 0.77$, $p = 0.51$). Further analysis revealed that in the total group highly anxious children had a higher mean Venham score ($F(1,135) = 13.44$, $p < 0.001$), displayed more pain related behaviours ($F(1,135) = 10.15$; $p = 0.002$) and self-reported a higher pain score ($F(1,135) = 1245$, $p = 0.001$) than low anxious children (Table 78).[246]

Table 78 Mean and standard deviation for the mean Venham scores, mean number of pain related behaviours and self-reported pain during the first and second treatment sessions

	N	Mean Venham	Mean behaviours	Pain child
First treatment session				
Injection technique				
Traditional	74	1.48 (1.24)	1.14 (1.27)	2.77 (3.00)
Wand®	66	1.38 (0.94)	1.03 (0.83)	3.26 (3.27)
Level of dental anxiety				
Low	87	1.18 (0.91)**	0.87 (0.88)**	2.28 (2.67)**
High	53	1.85 (1.27)**	1.45 (1.27)**	4.19 (3.47)**
Second treatment session				
Injection technique				
Traditional	64	1.50 (1.17)	1.19 (1.20)	3.77 (3.30)
Wand®	55	1.31 (1.21)	0.89 (1.21)	3.49 (3.40)
Level of dental anxiety				
Low	73	1.28 (1.11)	0.98 (1.17)	3.32 (3.27)
High	46	1.62 (1.28)	1.17 (1.26)	4.15 (3.41)

Yogesh et al compared pain perception, behavioural response, and physiological parameters during LA administration with cartridge syringe and computer controlled local anaesthetic delivery system (CCLAD) in 120 children (aged 7-11 years).[241]

Children were randomly divided into those receiving injection with CCLAD during first visit and those receiving injection with cartridge syringe during first visit. Pulse rate and blood pressure were recorded before and during injection procedure and the washout period between the two treatment visits was 1-week. Results showed that injections with CCLAD produced significantly lesser pain response, disruptive behaviour ($p < 0.001$), and pulse rate ($P < 0.05$) when compared to cartridge syringe injections.[241]

Technique

Kudo conducted a study to assess injection pressure, pain, and anxiety at the start of LA injection into the oral mucosa, and also confirm the relationship between injection pressure and pain, and between injection pressure and anxiety in 28 healthy men.[233] A 0.5-inch (12 mm) 30-gauge disposable needle attached to a computer-controlled local anaesthetic delivery system (the Wand) was used with 0.5 mL volume of local anaesthetic solution (2% lidocaine hydrochloride solution with 1: 80,000 epinephrine) injected submucosally at a speed of either 30 or 160 s/mL. Three seconds after the start of LA injection, injection pressure was measured and pain and anxiety were assessed, which showed a significant correlation between injection pressure and pain ($rs = .579$, $P = .00124$) and between intensity of injection pressure and state anxiety ($rs = .479$, $P = .00979$). The author recommended that LA be injected under low pressure (less than 306 mm Hg) to minimise pain and anxiety among dental patients. It was further shown that the target value of the low-pressure injection for reducing pain was 51 mm on the VAS (considered as moderate pain (85/170 mm) on the Heft-Parker VAS), which corresponded to injection pressure of 306.39 mm Hg. A FAS score of 3 (high level of state anxiety) corresponded to 363.44 mm Hg.[233]

In a case report by Wainwright (2008) the features and the use of Piezotome piezoelectric ultrasonic generator and Intralift method by Satelec® (Acteon Group) in the case of a 42-year-old female patient who had undergone an internal sinus lift were described.[247] Following the treatment, the patient reported that it was great, and was is convinced that general anaesthetic was not required for implants.

Technology

In a study conducted by Heaton et al in 2013 in 8 sites in the United States, Computer Assisted Relaxation Learning (CARL) was compared with an informational pamphlet in reducing fear of dental injections.[231] Overall, an average of 1.4 sessions was spent by participants with CARL in the intervention group; and those in the control group spent one session reviewing the pamphlet. Results showed that the mean fear scores post-treatment reduced in both the groups; however, the reduction was significantly greater in the intervention group. Differences in mean post-intervention MDAS scores between CARL and control conditions were statistically significant (12.5 vs. 18.5, effect size 1.42, $p < .001$). For DFS, mean postintervention scores were 54.5 and 71.1 in CARL and control conditions, respectively (effect size 0.97, $p < .001$). Participants completing CARL reported significantly greater reduction in self-reported general and injection-specific DA measures compared with control individuals ($p < .001$).[231]

Bartlett et al examined the effects of a structured telephone call after orthodontic appliance placement on self-reported pain and anxiety in 150 orthodontic patients (mean age 15.9 years) who were randomly assigned to three groups that included: structured phone call group (demonstrating care and reassurance), attention-only phone call group (thanking patients for participating in the study), and a no phone call or control group.[226] Results showed that significantly less pain ($p = 0.005$) and state-anxiety ($P = .033$) were reported in both telephone groups compared to the control group; however, there was no difference between the two telephone groups ($p>0.12$ for pain; $p>0.81$ for state-anxiety). In addition to significant group differences with respect to pain, there was also a significant reduction in state-anxiety during the week after initial orthodontic archwire placement ($p< 0.0331$) and the state-anxiety scores were reported to be highest at 4 hours for the two telephone groups and at 24 hours (1 day) for the control group.[226] Maximum mean state anxiety scores reported were 33.4 ± 1.4 for the structured telephone group, 33.2 ± 1.5 for the attention- only telephone group, and 37.0 ± 1.4 for the control group. Overall, results indicated that at the time of maximum state anxiety, both the telephone groups showed a 10% reduction in state-anxiety when compared with the control group.[226]

Keith et al in a RCT investigated whether a text message reduced the severity of patient self-reported levels of pain and anxiety following initial placement of orthodontic

appliances in 39 orthodontic patients.[232] Patients in one group received a structured text message showing concern and reassurance, while the second group (control) received no postprocedural communication. There was a statistically significant difference in pain in relation to time between the text message group and the control group. In addition, it was found that compared with the text message group, patients in the control group reported increased pain intensity and more self-reported discomfort. There were no group differences in relation to anxiety levels. State-anxiety was reported to be highest at day 2 and gradually decreased during days 4, 5, 6, and 7; however, post hoc analysis showed that there were no significant differences between the two groups (F=1.907, p=0.069) (Table 79).[232]

Table 79 Pain vs Time Group Means and Standard Deviations

Time of pain measurement	Text message (n = 20)	Control (n = 19)	Total (N = 39)
Baseline	15.10 ± 18.806	5.95 ± 7.742	10.64 ± 15.057
4 Hours after appointment	42.30 ± 24.155	41.42 ± 24.204	41.87 ± 23.863
Day 2	50.35 ± 20.833	58.42 ± 23.227	54.28 ± 22.119
Day 3	33.05 ± 19.750	48.89 ± 27.550	40.77 ± 24.878
Day 4	21.60 ± 17.783	39.68 ± 29.407	30.41 ± 25.527
Day 5	12.60 ± 12.824	21.42 ± 22.154	16.90 ± 18.294
Day 6	8.75 ± 11.016	11.37 ± 12.280	10.03 ± 11.570
Day 7	6.55 ± 8.864	6.68 ± 9.995	6.62 ± 9.307

Winick evaluated the effect of cranial electrotherapy stimulation (CES) in reducing anxiety in 33 patients during routine dental procedures.[248] The Alpha-Stim 100 CES technology (cost $595) was used to treat one group of patients with active stimulation and the other group without active stimulation. It was reported that the patients in the active CES treatment group were significantly less anxious when compared to the control group. Overall, dentists' rated VAS anxiety levels were less in the intervention group (-24 ± 6.4 (SEM)) compared to the control group (-7.2 ± 3.2 (SEM)); $p<0.02$. In addition, patients' self-reported anxiety levels were found to be similar to those of the dentists' ratings; treatment group (-30.1 ± 9.0 (SEM)) vs control group (-4.2 ± 3.9 (SEM)); $p<0.02$. The results from Likert scale were similar to the VAS ratings, which showed that those in the treatment group were less anxious: dentists' ratings for treatment group (4.4 ± 0.4 (SEM)) vs control group (2.3 ± 0.1 (SEM)), $p<0.01$; and patients' ratings for treatment group (4.8 ± 0.4 (SEM)) vs control group (2.5 ± 0.3 (SEM)); $p<0.01$.[248]

Web

Buchanan & Coulson conducted a qualitative study to explore the context through which dentally anxious individuals accessed an online support group and their online experiences with the support group. One hundred and forty three participants (aged 16–64 years) who accessed the Dental Fear Central (http://www.dentalfearcentral.org/), an online support group bulletin board completed an online questionnaire that was designed to explore their experiences of accessing the online group.[227] Three emergent themes were revealed that reflected the views and experiences of the participants: 'Searching for help', 'Sharing fears' and 'I feel empowered'.

'Searching for help' involved surfing and searching the worldwideweb for online support groups, such as Dental Fear Central. As one respondent explained ‘‘I began reading online support groups when I started considering returning to the dentist. My wisdom teeth were decaying and clearly needed to come out—one of them was falling out in chunks. I was completely terrified and did not know what to do, so I started doing a bit of research on wisdom teeth on the internet. At that point I did not really know that such a thing as ‘dental phobia’ as a proper condition existed, but I learned that as I was researching.[227] It was through googling ‘dental phobia’ that I found some online support groups’’. In terms of ‘Sharing fears’, majority of the respondents felt great comfort in knowing that they were not alone and for most of them, the presence of an online support group was beneficial in helping them overcome their fears; as one participant said: ‘‘Well I can say I clearly do not feel alone, and actually did find the name of a dentist who is 2 h from me, so I might get the courage to call him up and see what he can do’’. The third theme ‘I feel empowered’ revealed that participants through viewing and accessing the messages posted by others facing similar challenges and the guidance, support and encouragement offered, felt empowered that enabled them to confront their fear. One participant stated: “It gave me the courage to finally make my appointment. And the words of encouragement helped me to stay at the office and not run for my life’’.[227]

Further to their qualitative exploratory study, Coulson & Buchanan conducted another study to explore the self-reported effectiveness of an existing online DA support group in terms of perceived level of anxiety since accessing the group.[228] Similar to their previous study, an online questionnaire was completed by 91 participants (aged 16–64 years) who accessed the Dental Fear Central (http://www.dentalfearcentral.org/), during

an 8-week period. Overall, 60% of the participants felt that the support group had to a great extent reduced their anxiety and the overall mean MDAS score for the sample was 19.82 (SD = 5.05). The number of participants who scored above the cut-off of 19, indicating likelihood of dental phobia, was 64. As can be seen from the Table 80, males reported significantly higher levels of anxiety as indicated by total MDAS scores and also for two specific MDAS items: having a tooth drilled and having a local anaesthetic injection. In total, 17 members reported that their anxiety had greatly lessened; 38 somewhat lessened; 34 stayed the same; 1 somewhat increased, and 1 greatly increased.[228]

Table 80 MDAS scores for males and females

MDAS Items	Males	Females
Going to the dentist tomorrow	3.90 (0.99)	3.90 (1.24)
In the dentist waiting room	4.33 (0.86)	3.87 (1.27)
Having a tooth drilled	4.67 (0.48)	4.06 (1.25)**
Having a scale and polish	4.00 (0.84)	3.74 (1.29)
Having a local anaesthetic injection	4.48 (0.68)	3.79 (1.29)**
Overall score	21.38 (2.54)	19.36 (5.52)*

*P < .05, **P < .01

Similarly, Crawford et al in 1997 conducted a mixed methods study (survey and qualitative) to evaluate a support group for dentally anxious patients who were reluctant to visit the dentist and obtain dental care.[229] The study involved semi-structured interviews by group discussion, face-to-face or telephone with 14 (50%) members of the support group that explored their views concerning dental attendance and dental care before, during and after attendance at the support group. It was found that attendance at the support group was a major factor in alleviating fears and negative beliefs about dental care. Thirteen interviewees were also monitored during a course of treatment following support group attendance and they showed a significant ($P < 0.01$) reduction in Corah DAS score. The mean baseline Corah DAS score (measured after the attendance at the support group but prior to treatment) was 16.0 (SD 2.9) that dropped after treatment to 11.9 (SD 3.6).[229]

Participants reported several reasons to become involved in the support group. Firstly, respondents felt that they were alone in their feelings of anxiety towards dentists and dental treatment, as one respondent said, “I knew I probably needed treatment but it took

one of my front teeth to break to get me to do something about it…it was 90% fear and 10% apathy".[229] In terms of first visit to the support group, participants felt surprised to find that their fear and anxiety about the group disappeared rapidly once they started listening to others, as one participant said "I just sat there and listened initially, then they got me talking, I was really impressed, people understood how I felt but often for different reasons". All the participants found that their first attendance at the support group was a good experience, as one said "It's all about relationships so far as I'm concerned, that's how the support group works…you get to know people, you trust them …you trust the other people in the group and you trust X". The support group members felt that the group leader was the person most responsible for creating the supportive spirit of the group as one said "X has just a way bringing people into things" or as another said "X can instigate things he might need to know about".[229]

Table 81 Assessment of methodological quality (Equipment/Technique/Technology/Web)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Allen et al 2005	RCT	U	N	N	N	N	U	Y	Y	Y	Y	E	4
Bansal et al 2014	RCT	U	N	N	N	N	U	Y	Y	Y	Y	E	4
Bartlett et al 2005	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Belcheva & Shindova 2014	RCT	U	N	N	N	N	U	Y	U	U	U	E	1
Bondarde et al 2016	Quasi-experimental study	N	N	N	N	N	U	Y	Y	Y	U	E	3
Boyle et al 2010	Quasi-experimental	N	N	N	N	N	U	Y	Y	Y	U	E	3
Buchanan & Coulson 2007	Qualitative study	U	Y	Y	Y	Y	N	U	Y	Y	Y	I	7
Canbek & Willershausen 2004	Quasi-experimental	N	N	N	N	N	U	Y	Y	U	U	E	2
Coldwell et al 1998	RCT	U	U	U	N	U	U	Y	Y	U	U	E	2
Coulson & Buchanan 2008	Cross-sectional	U	Y	N	Y	Y	N/A	N	Y	U		I	4
Crawford et al 1997	Qualitative study	U	U	Y	Y	Y	N	U	Y	N	Y	I	5
Dähnhardt et al 2006	Quasi-experimental	N	N	N	N	N	U	Y	U	U	U	E	1
Darbar 2007	Case report	N	N	N	N	U	U	N	U	U	U	E	0
Goodell et al 2010	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Grace et al 2003	Quasi-experimental	N	N	N	N	N	Y	Y	Y	U	Y	E	4
Heaton et al 2013	Quasi-experimental	Y	N	U	N	Y	Y	Y	Y	Y	Y	I	6
Keith et al 2013	Quasi-experimental	U	Y	U	N	N	Y	Y	Y	Y	Y	I	6
Krochak & Friedman 1998	Quasi-experimental	N	N	N	N	N	Y	Y	Y	U	Y	E	4

Kudo 2005	RCT	U	Y	U	N	U	Y	Y	Y	Y	Y	I	6
Kuscu & Akyuz 2006	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Lazea & Todea 2016	Quasi-experimental	N	N	N	N	N	U	Y	Y	Y	U	E	3
Morse & Chow 1993	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Mosskull Hjertton & Bågesund 2013	RCT	U	N	U	N	N	Y	Y	Y	Y	Y	I	6
Nicholson et al 2001	RCT	Y	N	N	N	N	U	Y	Y	U	Y	E	4
Poli & Parker 2015	Quasi-experimental	N	N	N	N	N	U	Y	Y	Y	U	E	3
Queiroz et al 2015	RCT	Y	N	N	N	N	U	Y	Y	Y	Y	I	5
Restrepo et al 2011	RCT	Y	N	U	N	U	Y	Y	Y	Y	Y	I	6
Sayed et al 2016	RCT	U	N	N	N	N	U	Y	Y	Y	Y	E	4
Sarmadi et al 2014	Qualitative study	U	Y	Y	Y	Y	N	U	Y	Y	Y	I	7
Singh et al 2012	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Tellez et al 2015	RCT	Y	N	N	N	N	Y	Y	Y	Y	U	I	6
Touyz et al 2004	RCT	Y	Y	U	N	U	Y	Y	Y	Y	U	I	6
Ugurlu et al 2013	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Ujaoney et al 2013	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Versloot et al 2008	RCT	Y	U	N	N	N	Y	Y	Y	Y	Y	I	6
Wainwright 2008	Case report	Y	Y	U	U	N	N	N	Y	Y	U	I	4
Winick 1999	RCT	Y	Y	U	N	U	Y	Y	Y	Y	Y	I	7
Yogesh et al 2015	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6

4.4.11. Hand-Over-Mouth

Four descriptive cross-sectional survey studies were included in the review that examined the impact of using Hand-over-Mouth and/or physical restraint intervention on dental anxiety.[249-252]

Barton et al conducted a study to determine whether there was a significant difference in the number and severity of generalised fears and dental fears between patients who did and patients who did not experience hand-over-mouth and/or restraint as children.[249] One hundred twenty-two children were interviewed, 61 who had experienced HOM/restraint and 61 who had not. There were no statistically significant differences between the two groups in terms of generalised fears and specific dental fears ($p=0.86$ and $p=0.36$ respectively). It was further reported that twice as many HOM/restraint subjects described negative experiences in a physician's office or hospital when compared to the other group and this difference was statistically significant ($p<0.01$).[249]

Brill conducted a study to compare parents' acceptance of passive restraint with their personal perception of their own anxiety and their evaluation of their child's emotional state while being restrained, in a sample of 100 children who needed passive restraint in order to complete their restorative dental needs.[250] Following completion of dental treatment, surveys were mailed to the parents who were in the operatory during the restorative procedure. In addition, the treating dentists also evaluated their apparent levels of apprehension and the behaviour of the children while being restrained, using the Sarnat Scale. The results showed that there was no significant difference between the percentages of parents that felt no anxiety vs. moderate to severe anxiety. It was further reported that 10% of the parents felt their child did not mind being restrained, while the rest felt that their child was either unhappy but accepting or unhappy and not accepting of restraint. The passive restraint device was not specified in this study.[250]

Frankel in 1991 conducted a survey of 74 mothers to determine their attitudes toward the use of a Papoose Board (PB, a physical restraining device) to treat their uncooperative children (mean age 3.1 years).[251] At that dental appointment, the child was placed in the PB and teeth were restored using LA, mouth prop, and/or nitrous oxide. Fifty completed surveys were returned, and the survey results showed that 90% of the mothers

approved of the use of the PB, 96% thought the PB was necessary to perform the dentistry, 78% did not think it had a later negative effect on the child, and 86% were willing to use it with their next child.[251]

Newton et al in a study explored the views of 216 paediatric specialist dental practitioners in the United Kingdom on the use of the HOM technique and physical restraint through the use of questionnaires.[252] The survey response rate 82·8%. Results revealed that approximately 60% of the respondents felt that HOM should never be used and those who accepted (32%) the use of HOM suggested that it should be used in cases where children are hysterical and exhibit tantrum behaviour. The percentage of survey respondents who endorsed the use of a physical restraint device for certain disabled patients was 62%; for very young patients was 39%; for premedicated patients was 20%; and for physically resistive patients was 14%. In addition, 24% of the respondents felt there were no psychological consequences of the use of HOM or physical restraint; and 51% felt that HOM would result in the child fearing dental treatment.[252]

Table 82 Assessment of methodological quality (Hand-Over-Mouth/Restraint)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Incl/Excl	Score
Barton et al 1993	Descriptive Survey	N	Y	N	N	U	Y	N/A	U	Y	I	3
Brill 2002	Descriptive Survey	N	Y	N	Y	U	N	N/A	Y	Y	I	4
Frankel 1991	Descriptive Survey	N	Y	N	N	U	Y	N/A	U	Y	I	3
Newton et al 2004	Descriptive Survey	N	Y	N	N	U	Y	N/A	U	Y	I	3

4.4.12. Hypnosis

Twenty three studies (five RCTs, two pseudo RCTs, two quasi-experimental studies and 14 case reports) were included in the review that examined hypnosis as a form of therapy to manage dental anxiety.[43, 54, 68, 69, 253-271]

Experimental studies

Eitner et al conducted evaluated the effectiveness of clinical hypnosis and its long-term effect in oral and maxillofacial treatment in 45 highly anxious and nonanxious patients who were divided into four groups: group A (one monitoring session without dental treatment being planned); group B (an additional instructional hypnosis, a hypnosis lesson without dental treatment); group C (underwent surgical intervention without hypnosis); and group D (patients receiving hypnosis were monitored in six sessions).[256] Overall, the results showed that during and following the dental treatment, there was a significant reduction in systolic BP, RR in patients who underwent hypnosis. Changes in RR, HR and BP for Groups C and D during Sessions 2 and 4: independent of their anxiety level, patients under hypnosis showed less of an increase or more of a decrease in corresponding values than the patients who underwent implant insertion without hypnosis.[256]

The long-term effectiveness of hypnosis was evaluated for Group D in Session 5, where RR decreased in the fifth session by −1.6 breaths/minute and HR by −6.0 heartbeats/minute. Of the anxious patients, 87.5% and 83.5% of the less anxious patients felt that the use of hypnosis influenced their attitude in dental treatment and they intended to take up hypnosis in the future. It was further reported that the anxious felt that their positive experience with the operation was due to the therapist performing the hypnosis (87.5%) and to hypnosis itself (87.5%) and the corresponding values in the less anxious patients were 33.4% and 66.8%.[256]

In another study by (pseudo-RCT) by Eitner et al, the effectiveness of a novel audio pillow with hypnosis text and relaxation music was evaluated in 82 dental-implant surgery patients to relieve anxiety over a 6-month period. Visual analogue scales combined with the Aachen Dental Treatment Fear Inventory (AZI) questionnaire were

used to quantify patients' subjective feelings of fear and it was reported that the AZI scores decreased in the hypnotherapy group and increased slightly in the control group; which were significantly different between the groups (p=0.000). Further, it was reported that during surgery, the average diastolic BP and HR decreased in the hypnotherapy group and increased in controls.[255]

Enqvist & Fischer in 1997 conducted a RCT to evaluate the effects of preoperative hypnotic techniques used by patients planned for surgical removal of third mandibular molars.[257] In this study, patients were randomly assigned to an experimental (listened to an audiotape containing a hypnotic relaxation induction) or a control (no hypnotic techniques) group. Results showed that anxiety levels before the operation increased significantly in the control group but remained at baseline level in the experimental group. The mean anxiety values for the control group and the hypnosis group are presented in Table 83.[257]

Table 83 Mean Anxiety at Preoperative Examination and Before Surgery as Measured by a VAS (0-10)

Factor	Control group	Experimental group
Anxiety at examination	2	5
Anxiety before surgery	4.9	4.4 (nonsignificant)

Wilcoxon signed rank test. p = .002 for control group; p = .05 for experimental group

Ghoneim et al investigated the usefulness of tape-recorded hypnosis instruction on perioperative outcome in 60 patients (aged between18 and 35 years; ASA physical status I or II) scheduled for third molar surgery. Patients were allocated to either an experimental group (received an audio tape to listen to daily for the immediate preoperative week, which guided the patients through a hypnotic induction and included suggestions on enhancement of perioperative well-being) or a control group (did not receive any tapes).[258] Patients in the control group reported a mean increase of 11.7 points on the Spielberger scale from the screening to the presurgery period, while those in the experimental group showed only a mean increase of 5.5 points during the same period (p=0.01).

Glaesmer et al conducted a controlled trial in patients undergoing tooth removal, which aimed at assessing patient's attitude toward hypnosis and comparing the course of DA before, during and subsequent to tooth removal in patients with treatment as usual (TAU) and patients with treatment as usual and hypnosis (TAU + HYP).[259] One hundred and

two patients in a dental practice were assigned to either the TAU group or TAU + HYP group. Results showed that more than 90% of patients had positive attitudes toward hypnosis. On the VAS, the mean level of anxiety was 4.8 (SD = 2.6) in the TAU group and 5.5 (SD = 2.9) in TAU + HYP group; however, the difference between the groups was not statistically significant (p=0.186). In addition, following tooth removal patients were asked to retrospectively assess their level of anxiety during treatment and to assess their level of anxiety after treatment. During treatment the mean level of anxiety was 3.6 (SD = 2.6) in the TAU group and 2.7 (SD = 2.1) in the TAU + HYP group. Patients receiving hypnosis (TAU + HYP) reported a significantly lower level of DA during treatment compared to those patients receiving treatment as usual (TAU) (p = .049). After tooth extraction the mean level of anxiety was 2.0 (SD = 2.0) in the TAU group and 1.4 (SD = 0.7) in the TAU + HYP group. There was no significant difference between the two groups after tooth extraction (p=0.159).[259]

Haines in 1988 conducted a quasi-experimental study involving 100 dental patients that compared directly and indirectly worded styles of hypnotherapy delivered either in-person or via audio-tape as preparation for dental treatment, to prevent patient's anxiety and pain distress.[263] Patients were randomly assigned to 5 groups: indirect-taped, direct-live, indirect-live, and direct-live and no-treatment control groups. Statistical analyses showed that hypnotherapy treatments were effective when compared with the control group, on various outcome measures.

Holdevici et al in a quasi-experimental study investigated the anxiety level towards the dentist and towards pain among 44 patients (age range between 18-61 years) with dental problems and the differences between patients with dental problems who underwent hypnosis in comparison to those who haven't.[264] The intervention program was based on using relaxation and Ericksonian hypnosis procedures. During this program, using relaxation and hypnosis techniques in the treatment of patients with dental problems was meant to solve specific problems. The results revealed a decrease in anxiety towards the dentist and towards pain for the patients who received Ericksonian hypnosis techniques. In relation to the pre and post application difference for the Ericksonian hypnotherapeutic intervention, results showed that the scores were lower for the two variables in the experimental group (anxiety towards dentist has shown a score of (t (85) =-4,155, p>.001) and pain (t (85) =-3,647, p>.001)). In the control group there were no significant differences between the scores of the anxiety towards the dentist and pain for

the two applications. A significant statistic difference was recorded between on the scores for anxiety towards the dentist and pain in the case of both groups. A significant difference was registered comparing post applying Ericksonian hypnosis techniques scores of the two groups, hence for the anxiety towards the dentist after the intervention, the score was (t(56) =-3,955, p>.001). For the level of pain after the intervention the score was (t (56) =-2,875, p>.001).[264]

Huet et al conducted a RCT to investigate whether hypnosis lowered the anxiety and pain associated with dental anaesthesia in 30 children aged between 5 to 12 years over a 3-month period.[265] Children were randomly assigned to two groups, one group receiving hypnosis and the other group who did not receive hypnosis at the time of anaesthesia. Anxiety was assessed using the modified Yale preoperative anxiety scale (mYPAS) at inclusion in the study (mYPAS1), initial consultation/on arrival in the waiting room (mYPAS2), in the dentist's chair (mYPAS3), and at the time of anaesthesia (mYPAS4). There were no significant differences between the two groups in relation to anxiety levels at the initial consultation (mYPAS 1) or the beginning of the second session (mYPAS 2, mYPAS 3). When approaching the dental chair on the day of the dental anaesthesia session, 12/29 and 15/29 children had mYPAS3 scores below 24 and 30, respectively, with no difference between the two groups. Anxiety scores during the dental anaesthesia procedure (mYPAS 4) were significantly lower in the intervention group compared to the control group (p=.0021).[265]

It was further reported that that significantly more children had mYPAS4 scores under 24 and 30 in the intervention group than in the control group, 12/14 versus 4/15 (p = .0047), and 12/14 versus 5/15, respectively, (p = .0129). Strong pain (VAS > 3) was reported significantly more frequently by children in the control group than in the intervention group (9/15 vs. 2/14; $\chi 2 = 6.43$; df = 1; p = .0112). The maximum pain score reported by one child in the hypnosis group was 5, whereas a score of least 7 was reported by 9 children in the control group.[265]

Morse et al in a quasi-experimental study involving 29 endodontic clinic patients (12-74 years old) evaluated the effectiveness of hypnosis in reducing DA.[269] There were significant anxiety-reduction changes at the conclusion of the visits as measured by increased salivary volume, increased salivary translucency, reduced salivary protein, increased salivary pH and reduced questionnaire-determined anxiety level. Hypnosis

was found to be significantly more effective than LA in anxiety reduction as measured by salivary changes and questionnaires.

Case reports of dental anxiety and dental phobia using hypnosis

Fourteen case reports that used hypnosis as a mode of treatment for alleviating dental anxiety and dental phobia were included in the review.[43, 54, 68, 69, 253, 254, 260-262, 266-268, 270, 271] Majority of the case studies were conducted in the US. In all the studies that described cases of patients undergoing hypnosis in various forms for alleviation of dental anxiety/dental phobia, the findings revealed that the patients were able to overcome their fear and phobia and were able to relax. Therefore, the patients were also able to complete their required dental treatment (without undue anxiety/phobia), which they had avoided for a significant number of years, mainly due to previous unpleasant dental experiences at a young age. However, it is to be noted that in these cases, hypnosis had to be performed for at least 2-3 sessions and in some cases, for 6-7 sessions.

The following table (Table 84) provides some details on the patient characteristics including the duration of their dental anxiety/phobia, the dental treatment/procedure carried out and the actual intervention i.e. hypnosis performed on the patients in all the case studies described. In all the cases described, hypnosis was proven to be successful and beneficial in reducing DA including severe DA and dental phobia in both paediatric and adult patients in any age range. The duration of anxiety/phobia duration may have been related to the number of sessions of hypnosis treatment. In addition, the cases provide good evidence that hypnosis can be beneficial in reducing dental anxiety in patients undergoing any type of dental procedure/treatment.

Table 84 Case reports of dental anxiety and dental phobia using hypnosis

Author/Year	Patient characteristics	Dental treatment	Hypnosis – no. of sessions and duration
Bar-Gil 1983[253]	A female in her twenties with severe DA for approximately 10 years	Extraction of a tooth due to dentoalveolar abscess	Hypnorelaxation therapy in conjunction with posthypnotic suggestions and 'in vivo' sensitisation over a few sessions
Bills 1993[254]	55-yr-old woman suffering from	Mainly dental restorative treatment	Self-hypnosis, visualisation, and use of the affect bridge to re-

	dental phobia for 47 years		access the early dental traumas over three sessions
Eitner et al 2006a[43]	54-year old female patient with DA (DAS>13) for around 14 years	Dental implant surgery	Non-invasive hypno-sedation over six sessions – hypnosis and relaxation techniques
Forgione 1988[54]	Case 1 - 32-year-old female with fear of loss of sensation in her mouth	Dental procedure not specified	Hypnorelaxation therapy performed over three sessions
	Case 2 - 38-year-old male with dental fear for approximately 25 years	Extraction of painful teeth	Self-hypnotic learning with patient being provided tapes to learn over two sessions
Gottlieb 2011[260]	10-year old child with DA for 5 years	Extraction of a tooth due to abscess	Hypnosis with explanation of the procedure performed in a single session
Gow 2002[261]	48-year-old female with severe DA (26/30 on a modified Corah's DAS). Duration of anxiety not clear	Restoration of several teeth and scaling and polishing of teeth	Hypnosis with progressive muscular relaxation technique, ego-strengthening, needle desensitisation techniques. There were performed over six sessions
Gow 2006[262]	31-year-old female with severe DA (16/20 Corah's DAS). Patient had a recent traumatic experience with birth	Tooth extraction	Hypnosis including self-hypnosis learning with needle desensitisation performed over three sessions
Kingbury 1980[266]	31-yr-old female with dental phobia for approximately 10 years	Extraction of teeth and restorations due to abscesses	Hypnorelaxation with ego-strengthening suggestions performed over three sessions
Kisby 1977[267]	11-year old female child with DA due to unpleasant previous dental experiences; the duration of which is unclear	Tooth extraction due to abscess	Hypnosis with eye fixation induction technique that included the application of Coue's Law of Reversed Effect – performed in a single session
Lamb 1982[268]	34-yr-old female with dental phobia for past 15 years	Restorative treatment and	Hypnotic imagery/fantasy-hypnotic induction that

		extraction of molar teeth	involved exposure to beautiful beach imagery, followed by age regression and exposure to negative imagery – performed over two sessions
Peretz 1996a[270]	13-year-old girl with severe DA for approximately 5 years	Composite restorations and a stainless-steel crown for a mandibular molar	Confusion technique to aid in hypnotic induction – included desensitisation, TSD and Ericksonian technique of deliberate confusion to initiate hypnosis – performed over four sessions
Peretz 1996b[271]	11-year-old boy with severe DA (20/20 on Corah's DAS) for approximately one year	Tooth restoration	Hypnorelaxation through suggestion and repetition - suggestions that involved conversation ending in four open-ended statements giving the boy a chance to be in control of the situation – performed over three sessions
Rustvold 1994[68]	5-year-old girl with dental phobia. Duration of phobia unclear	Urgent dental treatment	Self-hypnosis, relaxation-mental imagery and self-regulatory skills – performed over five sessions
Scott 1994[69]	30-year-old female with dental phobia for approximately 3 years	Scaling, tooth restoration and extraction	Hypnosis with graded exposure in combination with pharmacological agents – performed over four sessions

Table 85 Assessment of methodological quality (Hypnosis)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Abdeshahi et al 2013	RCT	N	N	N	N	N	Y	Y	Y	U	Y	E	4
Bar-Gil et al 1983	Case report	Y	Y	Y	U	N	N	U	Y	Y	U	I	5
Bills 1993	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5
Eitner et al 2006a	Case report	Y	Y	Y	U	Y	N	N	Y	Y	U	I	6
Eitner et al 2006b	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Eitner et al 2011	RCT	Y	N	N	N	N	Y	Y	Y	Y	Y	I	6
Enqvist & Fischer 1997	RCT	U	Y	U	N	Y	Y	Y	Y	Y	Y	I	7
Forgione 1988	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5
Ghoneim et al 2000	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Glaesmer et al 2015	RCT	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Gottlieb 2011	Case report	Y	Y	Y	U	U	N	N	Y	Y	U	I	5
Gow 2002	Case report	Y	Y	Y	U	U	N	N	Y	Y	U	I	5
Gow 2006	Case report	Y	Y	Y	U	Y	Y	N	Y	Y	U	I	7
Haines 1988	Quasi-experimental study	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Holdevici et al 2013	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Huet et al 2011	RCT	N	N	N	N	Y	Y	Y	Y	Y	Y	I	6
Kingbury 1980	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5
Kisby 1977	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5

Lamb 1982	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5
Manusov 1990	Case report	Y	U	Y	N	N	N	N	U	U	U	E	2
Morse et al 1981	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Peretz 1996a	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5
Peretz 1996b	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5
Rustvold 1994	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5
Scott 1994	Case report	Y	Y	Y	U	N	N	N	Y	Y	U	I	5
Smith 1985	RCT	U	N	N	N	N	U	U	U	U	U	E	0

4.4.13. Mixed

Fifty studies (19 RCTs, one block RCT, five quasi-experimental studies, two cohort studies, 10 cross-sectional studies, six case reports, one economic evaluation study, one qualitative study and five expert opinion articles) were identified in the review that evaluated and compared two or more interventions and their effect on dental anxiety.[11, 32, 57, 272-318]

Experimental studies

Adults

Berggren et al evaluated and compared relaxation and cognitively oriented therapy on dental phobia outcome in 112 adult fearful dental patients.[273] Results showed that a high percentage of patients who received cognitively oriented therapy completed the treatment program, but a significant reduction in anxiety was reported among patients who received relaxation-oriented therapy compared to the cognitively oriented therapy group. However, both the two treatment methods were shown to be effective in reducing dental phobia. In a pre- and post-test quasi-experimental study, participant modelling, symbolic modelling, and graduated exposure were compared with each other and with two control treatments for effectiveness in reducing fear of dentistry in 33 adults who had avoided dental treatment for from 1 to 10 yr.[275] Results showed that adults in the three intervention groups reported a significant reduction in state anxiety and expected pain. Additionally, it was reported that 2 years following treatment, 50 to 87.5% of the subjects were able to return to regular dental care, significantly more in the participant modelling condition group.[275]

Biggs et al in a RCT compared the effectiveness of two self-taught anxiety reduction techniques--breathing and focused attention--with a control group in a sample of 272 adult private dental practice patients.[276] There were no significant differences in anxiety between breathing, focusing, and control groups in terms of recall of anxiety experienced during prior treatment; however, there was a trend towards reduction in anxiety overall. It was interesting to note that patients in the control group who reported infrequent visits and use of their own anxiety reduction technique reported significantly reduced anxiety.

In a RCT by Corah et al in 1979 that evaluated and compared relaxation, active distraction with a control group during class II amalgam restorations in 80 adult patients, it was found that both relaxation and distraction were effective in reducing patient discomfort.[278] Following on from this study, Corah et al in the same year conducted another RCT to evaluate and compare relaxation, active distraction with a control group during class II amalgam restorations in relation to differences in reactions between men and women in a sample of 98 college students.[280] The analysis revealed that there was a significant main effect for gender with men reporting lower scores than women. In addition, the results showed that overall there was a significant reduction in dental anxiety after second visit. Further, reduction in anxiety levels were observed from visit 1 to visit 2 for all the patients.

Corah et al in 1981 in a RCT compared and evaluated relaxation and musical programming to reduce DA during dental operative procedures in a sample of 80 college students who required a minimum of two class II restorations.[279] It was found that relaxation was an effective method of reducing patient anxiety and the results with musical programs suggested that music, at best, resulted in a placebo effect, wherein the effect is similar to that of administering an inactive drug that produces beneficial effects in some patients some of the time.

Getka in 1992 investigated the effects of CBT and a semi-automated behavioural intervention for the treatment of DA and in addition, compared their effects to a waiting-list control and to a positive dental experience condition in 41 adults.[286] It was found that both the investigated interventions showed significant improvements in terms of DA level and negative thoughts during a dental procedure compared to the waiting-list control and positive dental experience conditions. In terms of self-efficacy, negative anticipatory thoughts, and pain experienced, the waiting list-control group did not improve significantly compared to the other three conditions. At l-year follow-up, patients treated with behavioural intervention and CBT reported less dental anxiety and had been to the dentist more often than WL controls.[286]

Hammarstrand et al compared and evaluated hypnotherapy (HT) and a behavioural treatment based on psychophysiological principles (PP) in a sample of 22 women (mean age of 31.8 years) with dental fear at a Dental Fears Research and Treatment Clinic.[288] In addition, a group with patients treated under general anaesthesia was used to compare

levels of dental and general fear with the two experimental groups. The results indicated that there was a statistically significant decrease in dental fear as well as a rise in mood during dental situations patients in the PP group when compared to the HT group.[288]

Harrison et al compared a modified form of systematic desensitisation with cognitive coping in 32 extremely anxious dental patients and the results indicated that there was significant reduction in DA in the systematic desensitisation group compared to those in the cognitive coping group.[290] Johnson et al compared and evaluated the effectiveness of relaxation and reassurance in 100 fearful and anxious patients about to undergo oral surgical procedures.[295] Patients were divided randomly into four groups: group one (patients received general surgical information about tooth removal); group two (patients listened to a relaxation tape); group three (patients listened to a combination of surgical information and relaxation information tape); and group four (patients had no intervention). There was a significant reduction in DA in group three patients, where EMG and temperature differences varied from the control group.[295]

Koleoso et al assessed the effectiveness of relaxation therapy, and cranial electrotherapy stimulation (CES) in the treatment of dental anxiety in a sample of 40 patients who had high dental anxiety.[298] Patients were equally assigned to each of the control and experimental groups (control =10, relaxation group =10, CES group =10, combined treatment group =10). Results indicated that both the interventions significantly reduced dental anxiety at post- test from pre-test ($t(164) = 11.33$, $p<.01$). Patients who were exposed to relaxation therapy (x =10.70; $p<0.05$), CES treatment (x =10.20; $p<0.05$), and the combined treatment (x =9.40; $p<0.05$) reported significantly lower dental anxiety compared to those in the control group (x = 18.30).[298]

Lahmann et al in a RCT compared a brief relaxation method (BR) with music distraction (MD) and with a control group (C) in sample of 90 adult patients (aged >18 years) with dental anxiety.[11] Patients in both the intervention groups reported significant reduction in DA; however, patients in the control group did not report a significant change in their anxiety level. In addition, it was found that BR was significantly superior to MD and was also effective in highly anxious subjects. Musical distraction was not found to have a clinically relevant effect in those patients.

Lundgren et al investigated and compared relaxation and a cognitively oriented treatment in a sample of 127 dentally phobic adult patients who were exposed to neutral and fear-

relevant video sequences.[300] It was found that both the treatments resulted in a significant reduction of dental fear. Miller et al examined the effects of EMG feedback and progressive relaxation training on the anxiety stress reactions of 21 patients (aged 21 to 48 years) having recurrent, negative reactions to dental treatment and who were randomly assigned to one of the three groups: EMG feedback, progressive relaxation, or control.[301] Results showed that there were significant, comparable decreases in EMG levels across dental appointments for both the intervention groups but not for the control group. However, on the DAS and STAI-State measures, significant decreases in all groups were found.

Moore and colleagues reported two studies in which they compared the effects of hypnotherapy (HT, individual self-hypnosis training) with group therapy (GT) and individual systematic desensitisation (SD) at the completion of the treatment and at a 3-yr follow up in adults (aged 19 to 65 years) with extreme DA.[302, 303] Results showed that in patients who completed treatment, HT, GT and SD were effective in reducing DA to the same degree. However, patients exposed to HT and SD required more therapist hours per patient compared to GT.[302] Following on from their previous study, Moore et al in 2002 reported on the results of the treatment after 3 years. After 3 years, 54.5% of HT patients, 69.6% of GT patients and 65.5% of SD patients were found to maintain regular dental care habits and it was found that specialist-treated regular attenders were significantly less anxious and had more positive beliefs than regular attenders from control groups.[303] It was also found that there were few differences between HT, GT and SD after 3 yr. Shaw et al investigated and compared the effects of systematic desensitisation and social-modelling treatments with placebo and assessment control groups and found that modelling was more effective than desensitisation.[307]

Vassend et al in a RCT investigated the effects of applied relaxation, cognitive therapy, and nitrous oxide sedation on dental fear in 61 adult patients. Following treatment, it was found that there was a significant reduction in dental fear and the three treatment methods equally effective in the short-term.[310] Willumsen et al similarly conducted another study to investigate the short-term efficacy of cognitive therapy and applied relaxation in dental fear treatment and to compare these methods with conventional pharmacological sedation (nitrous oxide sedation) in 65 adult patients with severe dental fear who received 10 weekly sessions of individual therapy.[315] Outcome measurement scores on dental fear showed that were significant reductions in dental fear compared

with pretreatment level for all treatment groups; however, there were no significant differences between the treatment methods.

Further, two follow up studies were conducted by the same authors that examined the long-term effectiveness of cognitive therapy and applied relaxation at one year and five years.[313, 314] At 1-year follow-up in 62 patients, it was found that there were significant reductions in dental fear and general distress and a majority (95%) of the participants had attended dental treatment in general practice.[314] It was also found that patients in the applied relaxation group reported largest reductions on the dental fear measures. At five years follow up, 43 patients who had responded to the treatment questionnaire reported that they had been to the dentist during the follow-up period.[313] Mean score on Corah's Dental Anxiety Scale (CDAS) was 10.4 (4.1) and there were no between-group effects. In addition, significant changes across the assessment phases (at enrolment, after treatment, and 5 years after) were reported for dental fear (CDAS: $F=137.8$, $p<0.01$).[313] The majority (81%) of the participants who assessed the dental fear treatment received 5 years previously reported that it was beneficial to them. In conclusion, the favorable effects on dental fear and general psychological distress continued at 5-year follow-up for all treatment groups.

Halvorsen et al[57] in 2004 conducted an economic evaluation study following up on the experimental studies by Vassend et al[310] and Willumsen et al[315]. The aim of this economic evaluation study was to discuss the social desirability of supplying dental fear treatment in addition to dental treatment in patients with severe dental fear. The authors in order to evaluate the effects of uncertainty on the patients' benefits from the program, examined patients' willingness to pay, before and after receiving treatment. The results suggested that only 24% of the patients were willing to pay the actual cost of the treatment before attending, but 71% were willing to pay after the treatment.

Wannemueller et al in a quasi-experimental study assessed the comparative effectiveness and acceptability of standardised hypnosis, hypnosis with individualised imagery, CBT and GA in the treatment of 37 patients with dental phobia.[311] The final analysis revealed a significant reduction of DA following CBT and individualised hypnosis when compared to the GA condition. However, standardised hypnosis was also reported to have a significantly higher rate of premature termination of treatment than CBT. Wannemueller et al[312] investigated the feasibility and effectiveness of a large-group one

session treatment (LG-OST) combining exposure and diaphragmatic breathing as a bodily coping element in a sample of 43 highly dental fearful individuals. Results showed that LG-OST showed medium to large effect sizes, (ranging from Cohen's d=0.51 to d=0.84) in regards to subjective dental fear. In patients who completed the treatment, subjective dental fear was reported to improve clinically significantly.

Children

Del Gaudio & Nevid in a RCT compared the relative effectiveness of exposure-based, multicomponent treatment for dental phobia in a sample of 68 school children.[281] This multicomponent treatment was administered in three group sessions consisting of coping-skills training administered in a school dental operatory setting, combined with exposure to a coping-model videotape. Results showed that exposure-based, multicomponent treatment was effective in reducing subjective anxiety when compared with waiting-list control, information dissemination/group discussion, video-tape-modelling condition, and non-exposure-based coping-skills-training conditions. However, no treatment group differences were reported for pulse or behavioural ratings of anxiety.

Farhat-McHayleh et al in a RCT compared and evaluated two modes of treatment, TSD and live modelling heart rates during dental treatments in 155 children (aged 5 to 9 years).[284] Heart rate is the most common physiologic indicator of anxiety and fear. Children were divided into 3 groups: children in groups A and B were prepared for dental treatment by means of live modelling, the mother serving as the model for children in group A and the father as the model for children in group B. The children in group C were prepared by a paediatric dentist using the TSD method. Results showed that children who received live modelling with the mother as model had significantly lower heart rates than those who received live modelling with the father as model and those who were prepared by the TSD method ($p<0.01$).

Ingersoll et al compared distraction and contingent reinforcement on dental fear in a group of 45 children (aged 3.5 to 9 years) who underwent dental restorative treatment.[293] Children were assigned to a cartoon-distribution condition (permitted to view videotaped cartoons) and to a cartoon-reinforcement condition (cartoons will only be displayed if the children remained quiet and cooperative) and to a control condition

(no cartoons displayed). Analysis of self-report VPT anxiety measures indicated that there were no significant differences between the two intervention groups; however, there was trend towards significant reduction in the contingent-reinforcement group.

Case reports of dental anxiety and dental phobia using a combination of interventions

Six case reports that used a combination of various interventions for alleviating dental anxiety and dental phobia were included in the review. Majority of the case studies were conducted in the US.[287, 292, 296, 297, 299, 316] In all the studies that described cases of patients exposed to a combination of interventions for alleviation of dental anxiety/dental phobia, the findings revealed that the patients were able to overcome their anxiety, fear and phobia. In addition, patients were also able to complete their required dental treatment. The following table (Table 86) provides some details on the patient characteristics including the duration of their dental anxiety/phobia, the dental treatment/procedure carried out and the actual intervention/s. The utilisation of a combination interventions as reported in these cases was required due to the severe levels of dental anxiety/phobia and the nature and extent of dental treatment needed to be carried out.

Table 86 Case reports of dental anxiety and dental phobia using a combination of interventions

Author/Year	Patient characteristics	Dental treatment	Intervention combinations
Gordon et al 1974[287]	A young female child, age unclear.	Dental examination, prophylaxis and treatment of caries	Modelling and desensitisation performed in nine sessions over a period 24 days prior to the actual dental treatment
Horowitz 1992[292]	40-year-old female with dental phobia since past 22 years	Radiographs, caries control and restorative procedures, oral health education and hygiene motivation, periodontal management and tooth extraction	Audiotaped relaxation, implosion, and rehearsal – performed over several sessions
	53-year-old female with severe dental anxiety for the past 21 years	Soft-tissue, restorative and prosthetic therapy	Audiotaped relaxation, implosion, and rehearsal – performed over several sessions

Kleinhauz et al 1985[296]	Case reports of 20 patients in the age range from 5 to 80 years with DA or phobia with or without predisposition to trauma	Routine dental examination, tooth restoration	Hypnosis, behavioural (desensitisation assertiveness training, modelling and role playing), psychodynamic therapy, relaxation, and suggestive techniques
Klesges et al 1984[297]	Very young (4-year-old) dental phobic girl with a long history of dental fear (>12 months)	LA administration and dental restorative procedures	A combination of graded exposure and utilising the mother as a coping model – performed over eight consecutive weekly sessions
Levitt et al 2000[299]	12-year-old boy who presented with dental phobia	Prevention, conservation and root canal therapy	Use of physical strategies, including muscle relaxation and relaxation breathing; practice strategies, including graded exposure and cognitive strategies, combined with individual control methods and inhalation sedation
Wilson 2006[316]	25-year-old-female with severe DA for the past seven years	Dental examination, scaling and polishing and dental restoration procedures	Hypnosis and a program of systematic desensitisation – including trance induction and deepening by progressive relaxation – performed over a total of 12 visits

Preference for nonpharmacological anxiety management technique combinations

Eleven cross sectional studies were included that reported on the preferences, views, beliefs and use of the combination of the interventions employed by dental practitioners and patients'/parents' views on those methods.[282, 283, 289, 291, 294, 305, 306, 308, 309, 317, 318] Overall, the cross-sectional surveys conducted in various countries showed that the general dentists and specialists utilised a broad range of anxiety management techniques, which mostly included psychotherapeutic interventions. In almost all the studies, it was reported that majority of the dentists were negatively affected or stressed out by patients with dental fear (Table 87).

Table 87 Cross-sectional surveys on the use of anxiety management techniques by dental practitioners

Author/Year	Population/Setting/Study aim	Interventions used/Results
Diercke et al 2012[283]	Young patients, general and paediatric dentists as well trained and untrained dentists. Germany	Almost every paediatric dentist employed one of the following methods: reducing waiting times (100%), describing the instruments appropriately to children (100%), making treatment easier to control (98%), using cuddly toys (96%), resorting to distraction (96%), making use of local anaesthesia (94%) and splitting up the treatment into several short sessions (94%). Conversations about fear (82%), relaxation technique (72%) and GA (62%) were well-established techniques of specialised dentists, too. Musical distraction (52%) and hypnosis (48%) were used by half of the paediatric dentists. Less common management techniques were medication (28%), video distraction (26%) and acupuncture (20%)
Diercke et al 2013[282]	65 practising dentists. Germany	The most preferred treatment techniques were reducing waiting times (100%), LA (99%), making the treatment easier to control by patients (96%), dividing the treatment into several short sessions (93%), and talking about patients' fear (93%). Fewer dentists favoured psychotherapeutic techniques like relaxation (53%) or hypnosis (19%).
Harding et al 2015[289]	Preferences of dental non-attenders (aged >18 years) for different anxiety management techniques. UK	Highly anxious patients were less likely to consider TSD techniques or watching explanatory videos compared to those with low or moderate anxiety. Other nonpharmacological techniques preferred included: hypnotherapy and psychological techniques in the majority of the patients
Hill et al 2008[291]	460 general dental practitioners' views and experiences on their current use of anxiety management techniques. UK	85% percent of dentists felt that they had a responsibility to help dentally anxious patients. Dentists utilised psychological techniques, sedation (oral, inhalation, or intravenous) and hypnosis. However, some dentists reported not using these techniques due to the paucity of time available in practice, a shortage of confidence in using these techniques and the lack of fees available under the NHS regulations.

Jevean & Ramseier 2016[294]	143 dental practitioners' views on the management of DA. Western Switzerland	Among the 119 respondents using anxiety reduction methods (85.0%), overall 51 (42.9%) reported using pharmacological methods, with the majority (89.9%; n=107) using psychological methods. Female dentists compared with their male colleagues used psychological anxiety reduction methods thrice more frequently than their male counterparts (borderline statistical significance (OR=3.0, p=0.0591)).
Peretz et al 2013[305]	Ninety parents' acceptance of management techniques in pediatric dental clinics. Israel	68.9% of the parents preferred to stay in the treatment room. The most accepted technique was positive reinforcement (81.1%) followed by TSD (76.7%, with younger parents more accepting than older, p=0.049). The least accepted techniques were restraint (1.1%) and voice control (7.8%, especially by parents with the highest DA, p=0.002).
Porritt et al 2012[306]	Investigated the current patient pathways used by 113 dentally anxious adults who had engaged with specialised dental services and 111 general dental practitioners. Sheffield, UK	Patients' recommendations for improving dental care experience: increased guidance and information to GDPs regarding available care pathways; improved availability of psychological services; and more opportunities and choice for patients in the long-term management of DA.
Smith et al 1991[308]	69 members of the Cincinnati Dental Society (including general dentists and specialists) and their views on treating fearful dental patients. USA	85% of the respondents indicated they were willing to spend more time with fearful patients, if compensated. Some anxiety management methods included: will stop immediately if patient indicates it hurts (99%), intraligamentary injection (86%), extensive interviewing (73%), Gow Gates injection technique (50%), explanation (45%), desensitisation (34%), distraction by television (9%), relaxation therapy (34%), biofeedback (5%), hypnosis (12%), music distraction (77%)
Tran et al 2010[309]	Preferences for anxiolytic interventions by dental practitioners (dental hygienists, dental assistants and dentists). Savannah, Chatham County area, USA	Most commonly used intervention was ambient background music (83.2%) and the second most commonly used intervention was having literature available for patients to read (75.6%), followed by providing a way for the patient to inform their provider of their anxiety (67.2%), the use of pharmaceutical agents (60.3%) and decorating the walls (51.9%).

Wright et al 1991a[317]	Beliefs, attitudes and the techniques used in the management of children with anxiety by 760 dentists. All States and Territories except Victoria in Australia	The most common techniques used: permitting the child some degree of control over terminating treatment if difficulties were experienced, coaxing and reinforcing positive behaviours, and furnishing waiting areas with child-oriented play materials. Most respondents never used TV or video-tape distraction strategies, film or video-modelling tape or hypnosis.
Wright et al 1991b[318]	267 dentists' attitudes and practices in the management of anxious children. State of Victoria, Australia	The most common strategies used by dentists in this study were: permitting the child to exercise some form of control over terminating the treatment, if they were experiencing difficulties; furnishing waiting areas with play materials; and using a TSD approach. Younger dentists tended to use behavioural strategies more frequently than older practitioners. Women dentists used following strategies more frequently than male dentists: spending more time with the child before entering the operatory; setting shorter appointment sessions; and permitting the child to hold a toy or a mirror during dental treatment.

Qualitative

Bernson et al conducted a qualitative study to better understand how patients with dental fear manage to undergo dental treatment.[274] The study involved 14 patients with dental fear who underwent regular dental care. Qualitative analysis of the interviews based on the principles of grounded theory resulted in four categories that explained how patients handled their dental fear and how dental care became possible. The categories were: taking part in a mental wrestling match, trust-filled interaction with dental staff, striving for control and seeking and/or receiving social support. The findings revealed that making dental care possible for patients with dental fear was a mutual challenge for both dental staff and the patients alike that would involve verbal and non-verbal communication including respect, attention, and empathy.

Expert opinion

A synthesised finding from five papers by experts in the field of anxiety management is reported in the figure below (Figure 13).[32, 272, 277, 285, 304] All the experts in the field are

in agreement that there are already a wide range of nonpharmacological interventions available to manage dental anxiety and dental fear and there is no need to create management techniques. Dentists need to be aware and trained in some aspects of intervention methods.

Figure 13. Synthesised findings from expert opinion papers on the use of various nonpharmacological techniques to manage dental anxiety

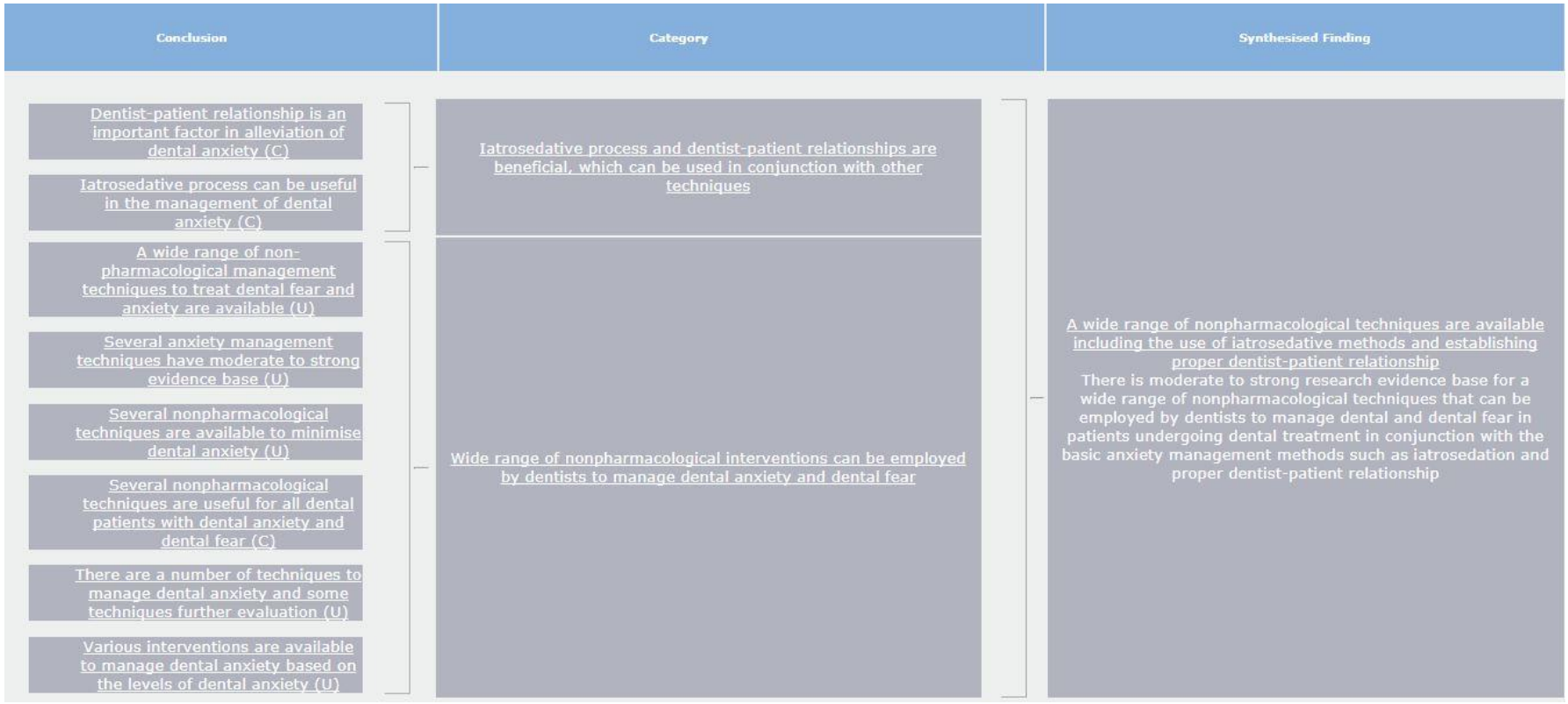


Table 88 Assessment of methodological quality (Mixed)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Incl/Excl	Score
Armfield & Heaton 2013	Expert opinion	Y	Y	Y	Y	Y	Y	Y					I	7
Ayer et al 1983	Expert opinion	Y	Y	Y	Y	Y	Y	Y					I	7
Berggren et al 2000	RCT	U	N	N	N	Y	Y	Y	Y	Y	Y		I	6
Bernson et al 2011	Qualitative study	Y	Y	Y	Y	Y	N	U	Y	Y	Y		I	8
Bernstein & Kleinknecht 1982	Quasi-experimental study	N	N	N	N	Y	Y	Y	Y	Y	Y		I	6
Biggs et al 2003	Quasi-experimental study	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Corah et al 1979a	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Corah et al 1979b	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Corah et al 1981	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Corah 1988	Expert opinion	Y	Y	Y	Y	U	Y	Y					I	6
Del Gaudio & Nevid 1991	Block RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Diercke et al 2012	Cross sectional	Y	Y	N	N	Y	N/A	N	N	Y			I	4
Diercke et al 2013	Cross sectional	Y	Y	N	N	Y	N/A	N	U	Y			I	4
Farhat-McHayleh et al 2009	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Friedman & Wexler 1990	Exp opinion	Y	Y	Y	Y	Y	Y	Y					I	7
Getka & Glass 1992	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Gordon et al 1974	Case report	Y	Y	Y	U	Y	N	N	Y	Y	U		I	6

Halvorsen & Willumsen 2004	Economic evaluation	Y	Y	U	Y	U	Y	N	N	N	Y	Y	I	6
Hammarstrand et al 1995	RCT	U	N	N	Y	N	Y	Y	Y	Y	Y		I	6
Harding et al 2015	Cross sectional	N	Y	Y	Y	Y	N/A	N	Y	Y			I	6
Harrison et al 1989	RCT	U	N	N	Y	N	Y	Y	Y	Y	Y		I	6
Hill et al 2008	Cross sectional	Y	Y	N	U	Y	N/A	N	U	Y			I	4
Horowitz 1992	Case report	Y	Y	U	Y	Y	U	N	Y	Y	U		I	6
Ingersoll et al 1984	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Jevean & Ramseier 2016	Cross sectional	U	Y	N	Y	Y	N/A	N	Y	Y			I	5
Johnson et al 1984	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Kleinhauz et al 1985	Case report	Y	Y	Y	Y	N	N	N	Y	Y	U		I	6
Klesges et al 1984	Case report	Y	Y	Y	Y	Y	Y	N	Y	Y	Y		I	9
Koleoso et al 2013	Quasi-experimental study	N	N	N	N	N	Y	Y	Y	Y	Y		I	5
Lahmann et al 2008	RCT	Y	N	Y	Y	N	Y	Y	Y	Y	Y		I	8
Levitt et al 2000	Case report	Y	Y	Y	U	Y	U	N	Y	Y	Y		I	7
Lundgren et al 2006	Quasi-experimental study	N	N	N	N	Y	Y	Y	Y	Y	Y		I	6
Miller et al 1978	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Moore et al 1996	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Moore et al 2002	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Newton et al 2012	Expert opinion	Y	Y	Y	Y	U	Y	Y					I	6
Peretz et al 2013	Cross sectional	U	Y	N	Y	Y	N/A	N	Y	Y			I	5

Porritt et al 2012	Cross sectional	U	Y	N	Y	Y	N/A	N	Y	Y			I	5
Shaw et al 1974	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Smith et al 1991	Cross sectional	U	Y	N	Y	Y	N/A	N	Y	Y			I	5
Tran et al 2010	Cross sectional	Y	Y	Y	U	Y	N/A	N	U	Y			I	5
Vassend et al 2000	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Wannemueller et al 2011	Quasi-experimental	N	N	N	Y	N	Y	Y	Y	Y	Y		I	6
Wannemueller et al 2016	Quasi-experimental	N	N	N	N	N	Y	Y	Y	Y	Y		I	5
Willumsen et al 2001a	RCT	U	N	N	N	N	Y	Y	Y	Y	Y		I	5
Willumsen et al 2001b	Cohort study	Y	Y	U	N	Y	Y	N/A	Y	Y			I	6
Willumsen & Vassend 2003	Cohort study	Y	Y	U	N	Y	Y	N	Y	Y			I	6
Wilson 2006	Case report	Y	Y	Y	U	N	N	N	Y	Y	U		I	5
Wright et al 1991a	Cross sectional	Y	Y	N	U	Y	N/A	N	U	Y			I	4
Wright et al 1991a	Cross sectional	Y	Y	N	U	Y	N/A	N	U	Y			I	4

4.4.14. Modelling

Nine studies (eight RCTs and one quasi-experimental study) were included in the review that examined the effectiveness of modelling interventions in reducing DA.[319-327]

Al-Namankany et al conducted a RCT to evaluate the effectiveness of video modelling in reducing DA in a sample of 180 children (aged 6 to 12 years) before the administration of LA who were randomly allocated to either a modelling video group or the control video group (oral hygiene instruction).[319] Results showed that children in the experimental group reported significantly less anxiety compared to the children in the control group throughout the subsequent dental procedure, particularly at the time of the LA administration ($p<0.001$). In another RCT conducted by the same authors that investigated whether video modelling reduced DA levels and increased patient's acceptance of the nasal mask usage for children receiving dental treatment using inhalation sedation in a sample of 80 children (aged 8 to 16 years).[320] Similar to their previous study, children in this study were also randomly allocated to either the modelling video group or the control video group (oral hygiene instruction). It was found that children in the modelling group reported significantly less anxiety after watching the video than those in the control group throughout the subsequent dental procedure; especially, at the time of the nasal mask administration ($p<0.001$).

The total scores for the dental part of the ACDAS had a possible range of 13–39. The total DA score difference before and after watching the video for the modelling group was 9.83, SD 4.99, and 0.26, SD 1.69 for the control group. In the modelling group 22.2 % of the participants showed no change in the DA scores for the nasal mask administration before and after watching the video, whereas 77.8 % of the control group showed no change in the DA score.[320] The scores of DA on the VAS was reported by each child throughout the dental treatment stages and the data are summarised in Table 89.

Table 89 The level of dental anxiety throughout the treatment

VAS stages	Modelling group (Mean ± SD)	Control group (Mean ± SD)	P value	Difference in means & (95% CI)
In the waiting room	4.66 8.02	15.07 ± 18.27	0.003	-10.41 (17.21 - 3.61)

Entering the dental clinic	19.88 ± 22.13	28.15 ± 21.24	0.13	-8.27 (18.96 - 2.43)
Sitting on the dental chair	5.32 ± 9.12	25.81 ± 21.24	0.001	-20.48 (28.36 - 12.61)
Examination with mirror	4.34 ± 10.81	37.35 ± 25.43	P<0.001	-33.01 (42.45 - 23.56)
Nasal mask application	7.79 ± 15.24	59.04 ± 30.93	P<0.001	-51.25 (62.86 - 39.63)
Local anaesthesia	26.34 ± 26.01	63.5 ± 30.35	P<0.001	-37.16 (51.02 - 23.3)
Tooth drilling	14.95 ± 24.83	50.25 ± 22.73	P<0.001	-35.30 (50.28 - 20.32)
Tooth extraction	31.92 ± 30.53	58.47 ± 28.19	P = 0.004	-26.54 (44.23 - 8.85)

Howard & Freeman assessed the effectiveness of the passivity to activity through live symbolic (PALS) after treatment modelling intervention to reduce child dental anxiety in a sample of 53, 5- to 10-year-old dental patients who were randomly assigned to either the intervention group (children in the intervention group were introduced to a glove puppet, which acted as the PALS mode and children re-enacted the treatment they had just received on the puppet's teeth) or control group (children received motivational rewards only).[321] The study results showed that there were no statistically significant changes in DA over the course of dental treatment in the intervention group, but interestingly in the control group, children reported a statistically significant decrease in DA between the first and second invasive dental treatment visits.

Howard in 1982 conducted a RCT to compare imagination modelling with film modelling for reducing dental-related fears in 60 children (aged 11 to 17 years), and were randomly assigned to three groups.[322] Children in the overt modelling group viewed a videotape of a model coping with restorations to be performed; children in the covert modelling group viewed a videotape including imagery practice, which guided them through restorations; and children in the control group saw a filmed reading of a descriptive passage. Results showed that both overt and covert modelling conditions were equally effective in reducing anxiety in this patient group and the authors concluded that to maximise decrease in anxiety over time, a combination of the two modelling strategies would be useful.[322] Klingman et al assessed the contribution of active participant modelling in coping skills training 38 children (aged 8-13 years), who were highly fearful of dentists.[323] Children were shown a videotape of 2 children practicing controlled respiration and imagery techniques while undergoing dental treatment. Children in the participant modelling group were encouraged to practice these as they

watched the film, and those in the symbolic modelling group were told that this might help them during their own dental treatment. Results showed that patients who had the active participant instructions obtained more information from the videotape, reported greater reduction in dental anxiety, and showed lower respiratory rates as they watched the videotape and they further reported greater use of imagery techniques and enhanced self-control.[323]

Logan et al conducted a study to determine the effect of video-taped role modelling on patient-reported level of anxiety at the beginning of dental treatment, in which patients were randomly assigned to three groups: role modelling video-tape; travelogue video-tape; and a control group.[324] Posttreatment measures of state anxiety showed statistically significant differences in favour of the modelling tape. Melamed et al in a RCT involving 16 children attending a pedodontic clinic compared a filmed demonstration of a child model cooperatively undergoing dental treatment with a film unrelated to dental activity.[325] It was found that the group viewing the modelling film showed significantly fewer disruptive behaviours during restorative care and were rated as less fearful than the control group.

In another RCT conducted by Melamed et al in 1978 to assess the effect of film preparation on 80 children (aged 4 to 11 years) undergoing 3 dental sessions (prophylaxis, examination, and restorative treatment).[326] Children were divided into two groups: peer modelling and demonstration of procedures. It was found that children exposed to a peer-model videotape presentation immediately preceding their own restorative treatment exhibited fewer disruptive behaviours and reported less anxiety than those watching a videotaped demonstration without a peer model. Heart rate activity was found to be less in those watching the modelling film. Further, it was found that children, aged 4 to 6 years had reported less fear after viewing a more complete synopsis of what to expect, and children, aged 8 to 21 years reported lowest levels of fears after viewing the peer model receiving a LA and brief intraoral examination. In addition, it was reported that children with previous treatment experience found the peer modelling intervention more beneficial. [326]

Paryab & Arab evaluated the effect of filmed modelling in comparison with TSD technique on the anxiety and cooperative behaviour in 46 children, aged 4 to 6 years and who were randomly allocated into two groups: Group I - at the first visit TSD technique,

and at the second visit, the treatment procedures were performed by the dentist for the children; and Group II - at the first visit, children watched a film consisting of the procedure of TSD performed on a child model and at the second visit, treatment procedures were performed.[327] Results showed that there were no statistically significant differences in heart rate measures, clinical anxiety and cooperative behaviour scores of children between the two groups (p= 0.6).

Table 90 Assessment of methodological quality (Modelling)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Al-Namankany et al 2014	RCT	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	I	9
Al-Namankany et al 2015	RCT	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	I	9
Howard 1982	RCT	U	Y	N	N	Y	Y	Y	Y	Y	Y	I	7
Howard & Freeman 2009	RCT	U	N	N	N	U	Y	Y	Y	Y	Y	I	5
Klingman et al 1984	RCT	U	N	N	N	Y	U	Y	Y	Y	Y	I	5
Kojian 1992	RCT	U	N	N	N	N	U	U	Y	Y	Y	E	3
Logan et al 1976	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Melamed 1975	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Melamed et al 1978	Quasi-experimental	N	N	N	N	Y	Y	Y	Y	Y	Y	I	6
Paryab & Arab 2014	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Zachary et al 1985	RCT	U	N	N	N	N	N	Y	Y	Y	Y	E	4

4.4.15. Parental Presence

Six studies (three RCTs, one pseudo RCT and two quasi-experimental studies) were included in the review that examined the impact of presence of a parent in the dental operatory room on dental anxiety.[328-333]

Afshar et al conducted a pseudo RCT conducted in Iran to evaluate anxiety and cooperation relative to parental presence in the first and second dental appointments in 5-year-old children (n=67).[328] Children were randomly assigned to a group with parent's presence and another group where parent was absent. Results showed that there were no significant differences between the heart rate measures and clinical anxiety scores of children in both the groups in the first and second visit (0.67 & 0.8; 0.98, 0.42 respectively (Table 91).

Table 91 Mean and SD values for the heart beat rate, the anxiety and cooperation level in Groups I and II (with/without parent's presence) in 5-year-old children presenting at the paediatrics dental clinic in their first and second visits

Group	Group I (With a parent present)	Group II (With no parent present)	P-value
1st visit			
Heart beat	95.40 ± 13.71	96.77 ± 12.22	0.67
Anxiety rating	1.38 ± 0.58	1.38 ± 0.55	0.98
Cooperation rating	3.00 ± 0.36	3.02 ± 0.32	0.88
2nd visit			
Heart beat	104.3 ± 15.78	103.4 ± 11.69	0.8
Anxiety rating	0.97 ± 0.45	1.10 ± 0.70	0.4
Cooperation rating	3.3 ± 0.35	3.2 ± 0.40	0.4

Cox et al assessed the effect of the presence of the parent in the dental operatory on their child's behaviour during dental treatment.[329] The study included 90 children (mean age 6.21 years). Results indicated that there were no significant differences in a child's perception of the treatment in relation to parental presence or absence and that the dentally anxious children behaved when the parent was not present in the operatory ($p<0.05$). In relation to the dentists' behaviour ratings, it was reported that the behaviour of the child started well, but gradually deteriorated during the course of treatment when the parent was not present in the dental operatory. Anxious (CFSS 32+) children were more likely to receive a higher behaviour score by the dentist and the children in the parent-absent group reported significantly more discomfort than the children in the parent present group ($p=0.037$). A non-significant trend for increase in DA was observed

during consecutive sessions in the parent absent group. Parents who were absent in highly anxious children group reported significantly higher discomfort of their child in the habituation session (p=0.039), but significantly lower during the second treatment (p=0.032) (Table 92).[329]

Table 92 Mean scores and standard deviations of the behaviour of children according to the child, parent and dentist for children with CFSS scores (low versus high) as independent variable.

CFSS-DS	Less anxious (15-32)			Highly anxious (32+)		
	Present	Absent	P value	Present	Absent	P value
Habituation (child)	1.52 ± 1.26	1.30 ± 0.66	0.75	1.68 ± 1.04	1.78 ± 0.85	0.48
Treatment 1 (child)	1.88 ± 1.36	1.55 ± 1.00	0.54	2.00 ± 1.63	1.74 ± 0.92	0.88
Treatment 2 (child)	1.72 ± 1.06	2.60 ± 1.54	0.04	2.68 ± 1.64	1.96 ± 1.40	0.09
Habituation (parent)	0.76 ± 1.17	0.55* ± 0.95	0.60	0.41 ± 0.80	0.91* ± 0.90	0.04
Treatment 1 (parent)	0.60 ± 1.12	0.60* ± 0.82	0.58	1.00 ± 0.98	0.91* ± 1.13	0.61
Treatment 2 (parent)	1.00 ± 1.32	0.85* ± 0.75	0.75	1.41 ± 1.10	0.78* ± 1.09	0.03
Habituation (dentist)	0.96 ± 1.10	0.40 ± 0.50	0.09	1.32 ± 0.95	0.74 ± 0.86	0.03
Treatment 1 (dentist)	0.68 ± 0.85	0.60 ± 0.88	0.66	1.50 ± 1.10	1.17 ± 1.15	0.34
Treatment 2 (dentist)	1.04 ± 1.14	1.35 ± 1.27	0.40	2.00 ± 1.23	1.04 ± 1.11	0.01

* Based on parent's estimate

Pani et al assessed the effect of parental presence on the behaviour of the child. The children (n=122, aged from 6 to 8 years) in this study were divided into three groups, those who had no accompanying parent, those accompanied by their fathers, and those accompanied by their mothers.[330] Subjective outcome measurements included the Venham anxiety and behaviour scores, whereas the objective measurement of fear was done by measuring the heart rate using a portable pulse oximeter at six different times. Results showed that females had a higher mean heart rate than males at all steps of the dental procedure. Children whose parents were outside the dental operatory showed lower anxiety and behaviour scores than those whose parents were present in the operatory; however, they showed a significantly higher pulse rate at all procedures. In relation to gender effect, boys had not statistical significant higher anxiety and behaviour scores compared to girls. Vasiliki et al in a RCT assessed the influence of parental presence during dental treatment on children's behaviour and perception.[331] The study

recruited parents of 100 patients (mean age 7 ± 2.2 years) who visited the Postgraduate Paediatric Dental Clinic and who were randomly divided into two equal groups: parent present in the surgery/operatory and parent absent (with their child observed through a window). Paediatric dentist's reported that the children's behaviour was worse when the parent was absent, with a significant difference only for the second restorative treatment session ($p = 0.011$); however, there was no difference on parents' rating child behaviour scores between the two groups. In both groups, the dentist rated lower Venham scores (better child behaviour), when compared to the parents (presence: $p = 0.001$, absence: $p = 0.038$).[331]

Venham way back in 1972 examined the effect of the parents' presence on the 'child's anxiety and behaviour in the dental operatory.[332] The study included a total of 89 children (aged from 38 to 94 months). Heart rate, a picture test and clinical anxiety rating were the outcome measures. Overall, the results showed that there was no significant effect related to the mother's presence or absence in the dental operatory. Wright in her dissertation examined the impact of parental presence on child anxiety in the paediatric surgery context.[333] The study comprised of 32 children undergoing dental surgery at the Department of Dentistry, Royal University Hospital in Saskatoon, Saskatchewan. The children's anxiety and pain scale (CAPS), a self-report measure was used to assess children's levels of anxiety and pain (scores range from 1-5). In addition, modified Yale Preoperative Anxiety Scale (mYPAS), a 22-itemt observer rated scale was used to measure child's level of anxiety.[333]

The outcomes were measured at five different time points: in the waiting room, 5 mins prior to leaving the day surgery room, when the child was separated from parents, when the anaesthetic mask was being placed on the child's face and when the child returned to day surgery room after the surgery. Results showed that regardless of parental presence, parent-rated anxious child temperament as measured by the Conners' Parent Rating Scales predicted increased observer-rated anxiety just prior to entering the operating room and at anaesthetic induction; and parental trait anxiety on the State-Trait Anxiety Inventory was associated with increased observer-rated child anxiety just prior to entering the operating room.[333]

Table 93 Assessment of methodological quality (Parental Presence)

Citation	Study design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Afshar et al 2011	RCT	N	N	N	N/A	N	Y	Y	Y	Y	Y	I	5
Cox et al 2011	RCT	Y	N	N	N	N	U	Y	Y	Y	Y	I	5
Freeman 1999	Case report	Y	U	Y	N	U	N	N	U	U	U	E	1
Pani et al 2016	RCT	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Shindova & Belcheva 2013	RCT	U	N	N	N	N	U	U	Y	Y	Y	E	3
Vasiliki et al 2016	RCT	Y	N	N	N/A	N	Y	Y	Y	Y	Y	I	6
Venham 1972	Quasi-experimental	Y	N	N	N/A	N	Y	Y	Y	Y	Y	I	6
Venham 1979	RCT	N	N	N	N	N	Y	Y	Y	Y	Y	I	5
Wright 2006	RCT	U	N	N	N	N	N	Y	Y	Y	Y	E	4

4.4.16. Miscellaneous

Six studies (two RCTs and four cross sectional survey studies) were included in the review that examined relatively new or recent forms or those that were previously uncategorised forms of treatment modalities to alleviate dental anxiety.[334-339]

Dentists' attire

Three studies examined the effect of dentists' attire on DA in children. Asokan et al examined the association between anxious states of children about dentists and their preference of dentist attire and gender in the dental office in a sample of 9-12-year-old middle school children.[334] Results showed that 69.9% of anxious children preferred coloured attires of the dentist, and 66.8% of anxious children preferred dentist with protective wear. In addition, it was reported that 66% anxious children preferred female dentists. Similar to the previous study, Babu et al examined the perceptions and preferences of children (n=150) towards dentists' attire.[335] Results showed that 53% of the children preferred traditional white coat attire and only 7% preferred attire was the professional attire. The child-friendly attire was preferred by 14% of the children. Interestingly, the results did not any significant differences between boys and girls preferences for dentists' attire. Around 49% boys preferred male dentists and 64% preferred female dentists. Nirmala et al in a cross-sectional survey evaluated the preferences of dentists' attire and gender by anxious and nonanxious children in India in a sample of 1,008 children (aged 9 to 14 years).[337] Anxiety levels were measured using the CFSSD subscale and children were provided with a series of photographs of dentists in different attires. It was reported that anxious children preferred female dentists in formal attire (19%) and nonanxious children equally preferred female dentists in formal attire and white coat with glasses (15%). Overall, it shown that the female dentist was the preferred choice for most of the children, irrespective of their anxiety levels.

Other interventions

Horovitz et al (2016) conducted a RCT to evaluate a promising novel treatment called Attention Bias Modification Training (ABMT) to reduce state anxiety among healthy

participants (n=71) waiting for dental treatment. Participants were randomly assigned to either: Dental ABMT group; Attention Control Condition (ACC) group; or Neutral Distraction group.[336] Participants in the ABMT condition were trained to shift attention away from the dental words, whereas in the ACC, the same stimuli were presented, but attention was not trained in any specific direction. The Neutral Distraction task consisted of a casual video game. Results showed that there was a significant interaction between time and condition on anxiety levels. Further, it was reported that participants in the Neutral Distraction group showed a significant reduction in anxiety levels from pre- to post-task (before dental treatment), compared to those in the ABMT or the ACC group. Following completion of dental treatment, only participants in the ACC group showed a decrease in anxiety levels, when compared to no change in the ABMT or the Neutral Distraction group.

Porritt et al evaluated patients' and professionals' experiences of a nurse-led dental anxiety management service (NDAMS), which operated as part of the Sheffield Salaried Primary Dental Care Service.[338] A total of 187 patients were assessed as suitable for NDAM (mean age = 33.7, 77% female) and 33 had completed it at the time of the service evaluation. Of the 33 patients who had completed the intervention, significant improvements in dental anxiety and oral health related quality of life (OHRQoL) were reported. It was further reported that integrated working, adequate support and training, and assessing the suitability of patients for NDAM were critical factors in the success of the service. The authors concluded that integrated care pathways that combine pharmacological and psychological management approaches help meet the needs of dentally anxious patients.

Yasemin et al recently published a trial that used humanoid robots to implement a techno-psychological distraction technique for children between 4-10 years of age to reduce their anxiety and stress-related pain during their dental treatment.[339] The intervention included a multimodal system supporting audio-based dialogues, videos, gestures and expressions based on face, head, arm, body movements developed for a robot. Children were assigned two groups: one group whose treatment was conducted by the dentist's own skills alone and the other group whose treatment was conducted by a dentist with the assistance of the robot. The results showed that the patients in the robot group had similar pulse rates before and during the dental procedure, indicating the

effectiveness of robots in reducing patients' anxiety. In addition, the total percentage of the patients having either no change or decrease in their pulse rate was 68.75% compared to 29.40% in the control group. In terms of acceptance of the intervention, the children in the robot group showed more positive attitude after the treatment than they did before the treatment (93.75%).[339]

Table 94 Assessment of methodological quality (Miscellaneous)

Citation	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Incl/Excl	Score
Asokan et al 2016	U	Y	N	Y	Y	N/A	N	Y	Y		I	5
Babu 2016	U	Y	N	Y	Y	N/A	N	Y	Y		I	5
Horovitz et al 2016	U	N	N	N	N	Y	Y	Y	Y	Y	I	5
Nirmala et al 2015	N	Y	N	Y	Y	N/A	N	Y	Y		I	5
Porritt et al 2016	N	Y	N	Y	Y	N/A	N	Y	Y		I	5
Yasemin et al 2016	U	N	N	N	N	Y	Y	Y	Y	Y	I	5

5. Discussion

The overall objective of this work was to identify and synthesise the best available effective, meaningful and/or appropriate evidence on non-pharmacological interventions in the management of DA and dental fear in paediatric and adult patients.

A larger number of studies in this series of reviews evaluated behavioural interventions alone compared to those evaluating other nonpharmacological interventions or in combination with other nonpharmacological interventions. Majority of the nonpharmacological interventions can be broadly categorised as psychotherapeutic interventions, which are either behaviorally or cognitively oriented. Interventions included psychological approaches such as one or five sessions of CBT; systematic desensitisation; biofeedback techniques; process simulations; eye movement desensitisation and reprocessing (EMDR) and completion of dental anxiety questionnaires with the knowledge that the dentist would be willing to discuss their anxiety. Results were found to statistically significant in majority of the RCTs. The use of music distraction, auricular acupuncture and aromatherapy (lavender scent oil) and were found to reduce dental anxiety among patients. Other outcomes such as reduction of avoidance behaviour, adverse outcomes and economic implication were scarcely evaluated in included RCTs. Economic implication of interventions were not reported in detail in any of the trials; however authors of the two complementary interventions concluded that they were inexpensive as they did not require any specialised equipment.

Computer assisted relaxation learning (CARL) which is based on systematic desensitisation and CBT were shown to reduce dental anxiety. This mode of administration could become useful and easily accessible to anxious adults from the comfort of their home. The reduction in dental anxiety was reported by various dental anxiety scales and questionnaires without uniformity or particular detail on number or percentage of participants who actually showed this reduction or the magnitude of the reduction. Adequate diagnosis and stratification of levels of dental anxiety among participants was reported in some studies with proper diagnosis it becomes easier to accurately measure rate of improvement of participants hence results are only generalisable without specific indication for management of people with lower or higher levels of dental anxiety/ phobia.

The majority of studies reviewed here, consistent with the meta-analysis by Kvale et al (2004)[76] showed that CBT techniques, delivered in a variety of formats (e.g. exposure with relaxation, cognitive restructuring, cognitive and behavioral approaches combined), modalities (e.g. individual, group), intervals (e.g. massed, spaced), and quantities (e.g. one session, five sessions), were efficacious at reducing dental anxiety and avoidance among adult patients in the short term and upon follow-up. Cognitive-behavioural interventions can be successfully delivered by practitioners of various training levels, from specially trained dentists to cognitive-behaviourally oriented clinical psychologists. Additionally, it is a promising finding that one-session CBT interventions can lead to substantial improvement. Results summarised in this series of reviews emphasise the importance of repeated, graduated exposure, whether or not it is paired with relaxation, biofeedback, or a cognitive component. Cognitive techniques, relaxation, and the provision of detailed information about dental procedures meant to increase patients' sense of control over dental care also appear to lead to a reduction in dental anxiety and avoidance; however, they perform best when combined with exposure.

Of the interventions including in this study, almost all the interventions were found to have evidence to support their use:

- Atraumatic restorative treatment/Chemo-mechanical caries removal
- Aromatherapy
- Acupuncture
- Audiovisual interventions
- Music
- Behaviour therapy
- Cognitive behaviour therapy (CBT)
- Hypnosis
- New equipment/technology
- Modelling

The evidence suggests that both ART and CMCR are comparable to, if not more beneficial than conventional restorative treatment in reducing DA, particularly in developing countries or in areas with lack of resources including electricity and water supply and equipment. The two treatment approaches provide an alternative approach to use of minimal equipment, minimal trauma, conservation of tooth structure and avoidance of LA; thereby avoiding potential triggering factors for DA that include dental injection and dental drill. The short time taken to complete the procedures, and the absence of local anesthesia and rotary instruments should be considered when dealing

with very young children or patients with behaviour problems. Overall the findings also showed that paediatric patients rated better or were more receptive to these two treatment approaches than the traditional or conventional restorative treatment because of less discomfort and probably because of the lack of use of rotary instruments and LA, which have been recognised as main causes of DA. The evidence on ART further showed that it was effective in reducing DA when compared to CRT at different times during the caries removal procedure, particularly at the start, deep excavation and restoration phases. Additionally, it was found that the outcome was dependent on the dental operator/s who had influence on the behaviour of the child and the levels of DA varied based on the various psychometric outcome measurement scales used.

However, despite the limitations and mixed evidence of effectiveness, particularly in relation to ART approach, the evidence suggests a favourable trend towards ART when compared to CRT in paediatric patients undergoing caries removal and tooth restoration in developing countries. The evidence for effectiveness of CMCR compared to CRT is more conclusive in terms of reducing DA and increasing patient acceptance; however, the length of time for performing CMCR was a concern for some paediatric patients included in the studies.

Evidence in relation to aromatherapy supports the use of essential oils in altering emotional states. It also suggests that essential oils, used as ambient odours, might be helpful to reduce anxiety and improve mood in dental offices. Orange and apple odours have no significant effect on the anticipatory anxiety or mood of patients waiting for scheduled appointments in large dental clinics. Toet et al. reported that additional distraction sources in the waiting rooms of large dental clinics, such as great background activity and continuous going and coming of patients, might influence the outcome. Ambient orange fragrance can be helpful in reducing DA during surgical removal of an impacted mandibular third molar.

In relation to auricular acupuncture, the findings suggested that the intervention was a suitable, effective and easy method to reduce DA. In contrast to midazolam, auricular acupuncture was not associated with prolonged sedation and the risk of respiratory depression. Avoiding these side effects may result in earlier discharge from the dental office and decreased costs. With the results of this study the anxiety-reducing effect of auricular acupuncture has been confirmed and is similar to that found for preoperative

anxiety and anxiety in prehospital transport settings. Auricular acupuncture, a minimally invasive method, effectively reduces state anxiety before dental treatment. However, the evidence is limited and inconclusive, but acupuncture can be seen as a promising therapy for the management of DA, where relevant and applicable.

Distraction, particularly in children is an effective strategy for diverting their attention from triggers of DA. Audiovisual distraction techniques are very useful for alleviating DA and calming patients, especially when seated in the dental chair. The use of music, 3D eyeglasses, games and other computerised tools/devices can aid in this process.

Music therapy or music listening was found to be an effective intervention in the management of DA in adult and paediatric patients. All the included studies evaluated or investigated music listening as an intervention, but none of the studies included music therapy as an intervention. 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.

Several studies have been on the effectiveness of AV interventions. Personal video eyewear is a portable video entertainment system that has the potential of providing a relaxed environment during dental treatment. In contrast to traditional AV programs that use a large television monitor above the patient's chair, this system includes a lightweight eyeglass system that has a built-in television monitor along with stereo earphones. Patients focus their attention on the relaxation video instead of anxiety-inducing dental equipment (syringe, drill, endodontic files, rubber dam) or noises. The music in the video coming through the earphones not only shields the drilling noise, but also, enhances the relaxation felt by the patient. It has been reported previously that such an AV system is beneficial in the reduction of fear and pain for both adults and children undergoing dental prophylaxis and restorative procedures.

Behaviour management techniques (BMTs) are utilised by dentists to alleviate children's DA. Children's perceptions of these have been underexplored, and their feedback could help inform paediatric dentistry. In addition, children's coping styles may impact

perceptions and effectiveness of BMTs and should be explored in future investigations.[143]. It is well documented that many behavioural therapy treatments are effective in treating dental fear with lasting effect. Not only is behavioural therapy acceptable and effective but it is likely that approximately 50% of people with dental phobia would be willing to see a psychologist for treatment of their dental fear.[148] Behavioural treatment programs have been shown repeatedly to be effective in alleviating DA but few studies have provided long-term follow-ups. Behaviour management techniques vary according to child's age and they might take a bit longer to achieve successful results because of the multiple visits required. It is well documented that many BMTs are effective in treating DA both in the short-term and long-term and therefore it is likely that people with dental phobia would be willing to see a psychologist for treatment of their dental fear.[148] Although, BMTs have been consistently shown to be effective in alleviating DA, only very few studies have been conducted that have provided long-term follow-ups in terms of their effectiveness and acceptability.

Tell-show-do is an effective technique for preparing new child patients; however, it has its limitations in reducing anticipatory anxiety in those who have had previous experience of dental treatment. Evidence showed that the techniques of TSD, positive reinforcement and voice control are highly acceptable and utilised by both the GDs and PDs, while the more specialised BMTs are often used by the PDs. Overall, HOM was found to be the least acceptable technique and is not recommended by the AAPD. In terms of parents' acceptability of BMTs, a majority of parents regarded the use of various BMTs as a key element for successful dental care for their children and most parents preferred the non-pharmacological techniques to pharmacological techniques. Dental anxiety management techniques that employed medications and restraint were considered least acceptable. In patients who present with mild fear and anxiety, dentists will be able to respond appropriately, if they become familiar with simple, behavioural interventions for DA.

Positive reinforcement is another useful technique to manage DA, which includes the reward for desired behaviours through the use of positive voice modulation, verbal praise, and appropriate physical demonstrations of affection by dental personnel. Dental phobia, surprisingly is more prevalent in the general population, which can be successfully treated through CBT that would enable patients to cope with dental treatments. Hypnosis may be useful method to overcome DA; however, because of the

considerable length of time generally required to achieve hypnotic state, many dental professionals believe that hypnosis is impractical in real-world clinical dental practice. The use of hypnosis without appropriate training and knowledge for alleviating DA during any dental procedure may have some undesirable effects; therefore the dentist should have a broad understanding of the hypnotic technique including its ramifications.

Some studies suggested that the dental office environment can play a role in triggering dental fear and anxiety in patients. Therefore, it is essential that the dental personnel create a relaxing atmosphere in the dental office to alleviate patients' DA. There are several ways to achieve this, which could include a combination of positive attitudes towards patients, efficient communication, music, aromatherapy, a sensory-adapted dental environment and dentists' attire.

There are various forms of relaxation techniques that the dentists can teach patients to calm them in the dental office. The basic relaxation technique refers is the deep breathing technique along with muscle relaxation. However, for techniques such as Ost's applied relaxation technique, Jacobsen's progressive muscular relaxation, functional relaxation, the rapid-relaxation technique, autogenic relaxation, the dentists need to be knowledgeable/trained and familiarise themselves with these techniques.

Biofeedback, a mind–body technique can be used to alleviate dental anxiety, but this requires the use of special devices such as respiratory rate-biofeedback device and special training. However, in real world clinical practice, this strategy may not be feasible as it is time consuming and probably not cost efficient.

Technology including tools and devices such as computer-controlled LA system (Wand device), electronic dental anaesthesia, lasers, and computer-assisted relaxation learning (CARL) should be considered in clinical practice to manage patients' DA. However, as with all the other interventions, these should be tailored according to patients' needs considering the feasibility aspect.

The results from studies related to the use of A/V eyewear support the use of those kinds of interventions as effective techniques to reduce anxiety in adults during dental treatment. The use of the IV eyewear was well received and accepted by patients. However, the cost-effectiveness of this technique has yet to be thoroughly researched.

5.2. Methodological limitations in reviewed studies

Although this series of systematic reviews provides some important results regarding which treatments are effective in reducing DA, many of the studies included in the review, particularly of lower level study design were methodologically weak to moderate. The RCTs included in this series reviews did not provide sufficient details on the method of randomisation, blinding and allocation concealment, suggesting that there was an inherent bias. Sample sizes varied across studies that limited the power necessary to detect potentially meaningful differences among treatments. Different studies used different measurement scales and criteria for measuring DA in addition to varied inclusion criteria regarding the level of DA required to be included in the study. Although many experimental studies assessed patients using common DA outcome measures such as the DAS, MDAS, CFSS-DS scales and their established cutoffs for high anxiety, there were other studies that used more general state anxiety assessments (e.g., STAI). Additionally, although some studies assessed patients using a combination of self-report scales, behavioural evaluations of attendance, SUDS ratings, and physiological measures (e.g., heartrate monitoring), the majority of studies did not use multi-method measurement. Several studies in the reviews did not report group differences in pre-treatment DA.

Overall, there was a lack of standardisation across studies for measuring the magnitude of dental anxiety in addition to having no clear definitions or ranges for treatment success. The results were based on statistical analyses, which implied that if there was a statistically significant reduction in DA and avoidance then the treatment was successful. Majority of the studies did not test for clinical significance or clinical meaningfulness of the results. Several studies lacked follow-up data, and it was not clear if the treatment that had been successful in the short-term would be beneficial in the long-term as well.

6. Conclusion

According to the evidence, the choice of an appropriate therapy method should take into consideration the individual needs, DA status of the patient, clinician's judgement and the availability of the resources required to implement the intervention. In addition, patient preference should also be taken into consideration. The most effective treatment for DA will be one that is tailored specifically for each individual patient. The results of this series of systematic reviews revealed that nonpharmacological interventions are useful for clinicians when planning anxiety management of patients with dental anxiety and fear who undergo various dental procedures. Taking cost-effectiveness into consideration, and absence of any side effects with lack of concerns about recovery, the information and recommendations provided in this series of reviews could lead to more appropriate decisions regarding anxiety management in dentistry.

On the basis of the best available evidence, the following conclusions can be drawn. The two minimal intervention dentistry approaches, atraumatic restorative treatment and chemo-mechanical caries removal are useful approaches to consider in reducing DA in paediatric patients, aged between 4-7 years when compared to conventional restorative treatment; more so in developing countries where there is a lack of resources in terms of lack of supply of sufficient water and electricity. ART and CMCR (either Carisolv or Papain gel) are well accepted compared to the use of rotary instruments and local anesthesia, the main triggers of DA. The minimal intervention dentistry philosophy of these two treatments results in less discomfort including anxiety and pain due to smaller cavity preparations. CMCR when compared to conventional restorative treatment resulted in less DA post treatment and hence was more acceptable to patients. In contrast there was mixed evidence on ART in terms of DA and treatment time compared to CRT.

The type of restorative material to be used to fill cavities after caries excavation in ART should also be considered (glass ionomer cement (GIC) instead of amalgam). Patients who experience discomfort during the first treatment session are likely to report discomfort during subsequent treatment session, which may be linked to anticipatory anxiety. When considering ART and CMCR in the management of DA in paediatric patients, the influence of the environment (i.e. dental clinic setup or school environment) and dental staff attitude and behaviour should be considered to create a more relaxing

environment for the paediatric patients. It can be concluded that paediatric and adult patients experience less discomfort including DA and pain when receiving dental treatment using only hand instruments than those treated using rotary instruments and LA.

Although this review provides evidence in favour of the use of orange essential oil in dental settings by reducing salivary cortisol and vital signs, further studies can be taken up with larger sample size, in children of lower age range, and in children with history of dental treatment. In addition, this review provides evidence in favour of the use of lavender scent in dental settings as a low cost, simple intervention for alleviating affective components of dental patient anxiety. The results are likely to be generalizable to patients with levels of DA below the level of phobia who are attending general dental practice. Auricular acupuncture could be an option for patients scheduled for dental treatment, who experience an uncomfortable degree of anxiety and request an acute intervention for their anxiety.

The results from two studies on paediatric patients provide inconclusive evidence on the effectiveness of music in reducing DA in this population. Choosing music correctly based on patients' preferences reduces the noise of the dental drill and diverts attention from the procedure. It will improve the ability of coordination treatment, shorten therapy time and help patients to reduce stress during dental procedure. Patient preference for the choice of music should also play a role. 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.

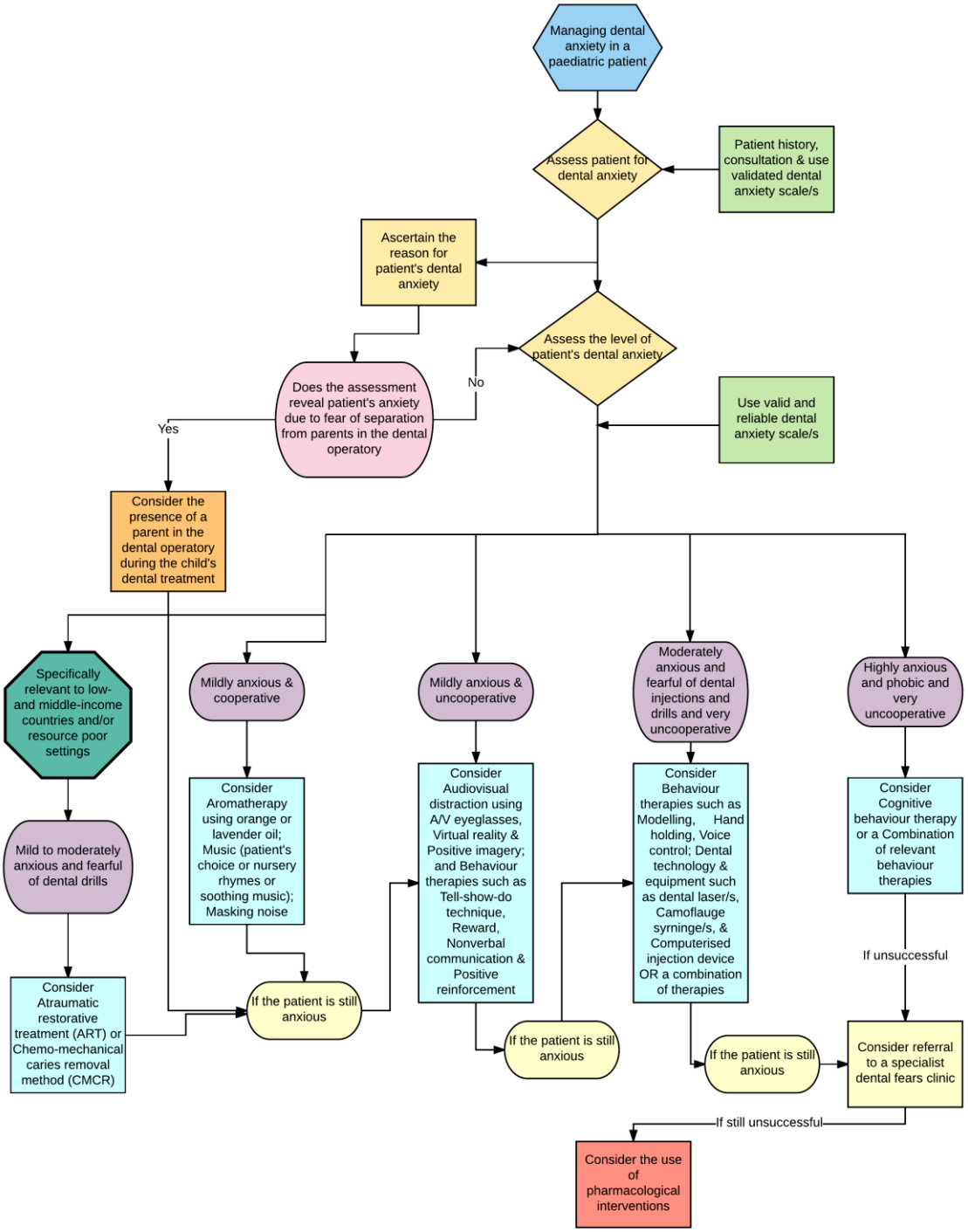
Video modelling appeared to be effective at reducing DA and has a significant impact on the acceptance of the nasal mask administration for Inhalation Sedation in children. Preparation of children with pictorial story can be effective in decreasing pain perception and situational anxiety as well as improving behaviour during dental treatment. Virtual reality eyeglasses can successfully decrease pain perception and state anxiety during dental treatment. AV eyeglasses successfully reduced pain, physical distress, and HR during local anaesthesia injection. Choice-based distraction using a variety of music, audio stories is a relatively easy procedure to implement, it may provide health care professionals and parents alike with a valuable alternative means of reducing the distress of children who visit the dentist.

A virtual image A/V system is beneficial in the reduction of fear, pain and procedure time for most dental prophylaxis patients and the use of screening questionnaires may be helpful for identifying anxious patients. An audiovisual device may be beneficial to the clinician and the mildly or moderately anxious patient. The use of immersive VR distraction may be an effective method of pain control during SRP procedures. Positive dental images have an effect on reducing anxiety as compared to neutral images when measured by the VPT.

Fear of dentist should not cause avoiding dental treatments. Not having regular follow-up examinations may multiply potential oral problems and make them even more complex. Small caries lesions tend to become worse and inevitably damage dental pulp making endodontic intervention necessary, which is more complicated and expensive. Also, gum inflammation not treated adequately and on time could lead to periodontal problems and tooth loss with functional, aesthetic and sociological consequences. Key to success in neutralising dental fear is trustful relation established between patient and dental practitioner. Therapists should fully understand patient`s stress, have patience and time to listen the patient and recognize the cause of such condition. In addition, dental practitioners have to be skilled and educated to treat such patients. Individual approach to each patient, timely recognition and gradation of dental anxiety are necessary in order to perform adequate and successful treatment.

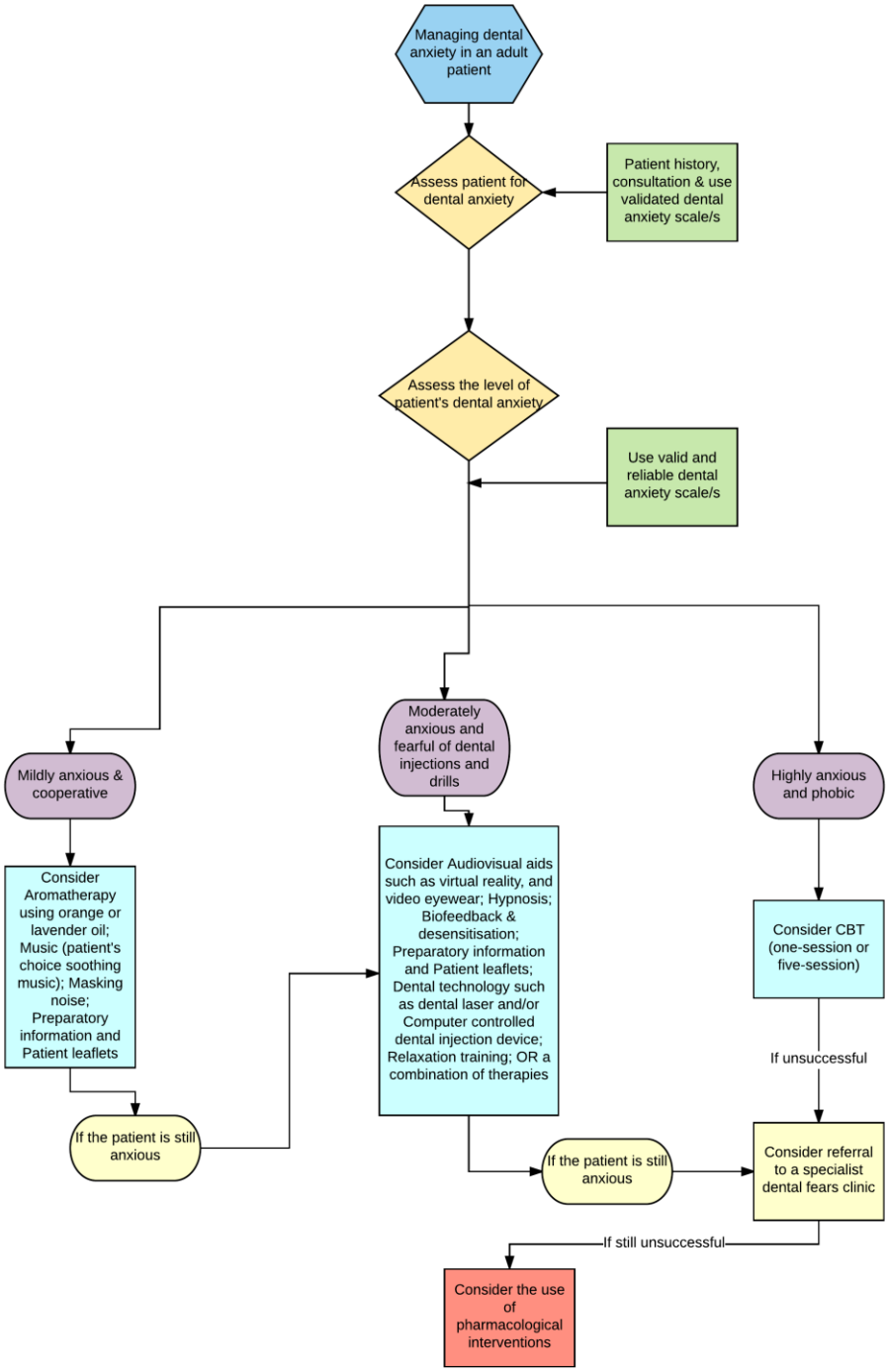
To conclude, the aetiology for DA is multifactorial, and there is no one intervention or strategy to manage or reduce DA. The management involves proper evaluation of the patient and identifying their source and level of anxiety and to appropriately maintain every aspect of the dental practice.

Figure 14. Decision making algorithm for the nonpharmacological management of dental anxiety in paediatric patients



Notes: Always consider the needs and preferences of the patients. Consider resource- and time-efficient intervention/s relevant to type of anxiety, patient's needs/preferences, relevant outcome and clinician's judgement. Sole usage of the Algorithms should not be considered a substitute for decisions related to assessment and management of dental anxiety in paediatric patients

Figure 15. Decision making algorithm for the nonpharmacological management of dental anxiety in adult patients



Notes: Always consider the needs and preferences of the patients. Consider resource- and time-efficient intervention/s relevant to type of anxiety, patient's needs/preferences, relevant outcome and clinician's judgement. Sole usage of the Algorithms should not be considered a substitute for decisions related to assessment and management of dental anxiety in paediatric patient

7. Implications for practice

- Atraumatic restorative treatment should be considered as a useful treatment approach to reduce dental anxiety in paediatric patients, particularly in developing countries; however, clinician judgment is required in terms of procedure time, patients' needs, context and availability of resources when deciding between ART and CRT. (Grade B)
- Chemomechanical caries removal method is recommended as a useful alternative to reduce dental anxiety in paediatric patients and improve comfort levels experienced by paediatric patients, particularly in developing countries; however, dentists and dental operators should consider the procedure time relative to the time taken to complete conventional restorative treatment. (Grade B)
- ART and CMCR should be considered by oral health policymakers in their outreach strategies, particularly in rural areas, low socio-economic areas and in areas where there is a lack of resources such as lack of electricity and water supply and minimal equipment. (Grade B)
- 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 should be considered as an adjunctive therapy, where possible with other distraction techniques in managing dental anxiety in children. (Grade A)
- Dental care professionals should consider adopting music in their daily practice. Dental offices/operatories should be equipped with music with headphones and small compact CD players. (Grade B)
- 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. (Grade B)
- Loud music should be avoided. Soothing and relaxing should be the preferred choice of music. (Grade B)
- Hypnosis is beneficial as an adjunct to other interventions, particularly behavioural and CBT interventions to reduce anxiety in dental patients undergoing routine dental procedures such as oral prophylaxis, restorative dental

treatment and/or tooth extraction/removal and in patients with low levels of dental anxiety. (Grade B)

- There is limited empirical evidence that hypnosis is beneficial in patients undergoing extensive dental procedures and in patients with high or extreme levels of dental anxiety/dental fear. Hypnosis, even as an adjunct therapy should be used with caution in these patients. (Grade B)
- Behavioural management techniques are recommended in paediatric and adult patients to reduce dental anxiety as they have the added benefit of no side effects or worsening of the condition. (Grade B)
- Behavioural techniques such as Tell-Show-Do, effective communication, voice control, modelling, positive dental personnel attitude and distraction are particularly effective in children. (Grade B)
- Behavioural techniques such as audiovisual distraction, communication, coping and desensitisation are particularly effective in adult patients. (Grade B)
- Adults with dental anxiety/fear/phobia and even in people with extreme or severe dental anxiety should be treated with behavioural management techniques to increase their acceptance of dental care. (Grade B)
- Aromatherapy with either orange or lavender scent/odour should be considered as a useful adjunct therapy to alleviate and/or reduce dental anxiety.
- Aromatherapy through the ambient use of lavender or orange scent in dental settings is recommended as a low cost, simple intervention for alleviating dental patient anxiety attending general dental practice undergoing routine dental procedures, particularly in those with low levels of dental anxiety/fear/phobia.
- There is limited empirical evidence on the influence and /or effect of aromatherapy on more complex and fearful dental procedures and in patients with high levels of dental anxiety. (Grade B)
- Very limited empirical evidence precludes the recommendation of acupuncture, particularly auricular acupuncture in alleviating patient dental anxiety or dental pain. (Grade A)
- A good patient–dentist relationship that includes an effective two-way communication is an important strategy for the management of dental anxiety. (Grade B)

- The ambience of the dental office including the waiting room and the operatory play an important in alleviating patient dental anxiety, particularly in children. (Grade B)
- The use of lasers for tooth cavity preparation will likely reduce pain and/or discomfort, thereby reducing anxiety and fear of pain during treatment. (Grade B)
- Technological advancements such as computer controlled anaesthetic delivery system, electronic dental anaesthesia, Computer Assisted Relaxation Learning (CARL) and laser therapy should be considered to alleviated dental anxiety in paediatric and adult patients. (Grade B)
- Patients with low to moderate levels of dental anxiety can be managed using behavioural interventions; however, in patients with extreme or severe levels of dental anxiety/phobia a combination of treatment approaches may be required. (Grade B)

8. Implications for research

There is considerable research evidence (although not robust for all interventions) to support the use of majority of the nonpharmacological interventions examined in the management of dental anxiety and dental fear in variety of dental settings and in all age groups. The conduct of more trials or studies in future on the majority of the interventions that have already been proven to be beneficial and acceptable to the patients will result in duplication of research and research waste in terms of resources and time required. Future research studies in the area of dental anxiety management should focus on the cost-effectiveness of interventions, the experiences of patients who receive them and the applicability in various cultures and/or geographical settings. Assessing the influence of nonpharmacological interventions on more complex and fearful dental procedures is also recommended for future studies.

Conflict of interest

None

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Appendix I: Search strategy

Medline (PubMed)

Search	Query
#1	Dental anxiety[mh] OR Dental anxiet*[tw] OR Dental Distress[tw] OR Dental fear*[tw] OR Dental phobi*[tw] OR Dentophobi*[tw] OR Fear of dental care[tw] OR Fear of dentist*[tw] OR Fear of dentistry[tw] OR Fear of dental hygienist*[tw] OR Fear of dental therapist*[tw] OR Fear of going to the dentist*[tw] OR Odontophobi*[tw] OR (dental[ti] AND (anxious[ti] OR anxiet*[ti]))
#2	3D video glasses[tw] OR Acupuncture[mh] OR Acupuncture[tw] OR Acupuncture therapy[mh] OR Acupuncture, Ear[mh] OR Adaptation, Psychological[mh] OR Alternative technique*[tw] OR Applied tension*[tw] OR Aromatherapy[mh] OR Aromatherap*[tw] OR ART[tw] OR Atraumatic restorative treatment[tw] OR Attire[tw] OR Audio[tw] OR Audiorecording*[tw] OR Audiovisual aids[mh] OR Audiovisual[tw] OR Audiovisuals[tw] OR Audio-visual*[tw] OR Auditory masking*[tw] OR Behavioral[tw] OR Behavioural[tw] OR Behavior control[mh] OR Behavior control[tw] OR Behaviour control[tw] OR Behavior management[tw] OR Behaviour management[tw] OR Behavior modification*[tw] OR Behaviour modification*[tw] OR Behavior therapy[mh] OR Behavior training[tw] OR Behaviour training[tw] OR Biofeedback, Psychology[mh] OR Biofeedback[tw] OR Biopsychosocial[tw] OR Breathing exercises[mh] OR Breathing exercise*[tw] OR Broadcast Media[tw] OR Caring[tw] OR Chemo-mechanical caries removal[tw] OR Chemo-mechanical[tw] OR Clinical rehearsal*[tw] OR Cognitive therapy[mh] OR CBT[tw] OR Compassion[tw] OR Compliant Behavior*[tw] OR Compliant Behaviour*[tw] OR Communication[mh] OR Communication[tw] OR Community-based[tw] OR Complementary Therapies[mh] OR Computer aided self-help[tw] OR Conditioning (Psychology)[mh] OR Conditioning[tw] OR Consumer Health Information[mh] OR Consumer Health Information[tw] OR Contingent escape[tw] OR Cooperation[tw] OR Cooperative behavior[mh] OR Cooperative behavior*[tw] OR Cooperative behaviour*[tw] OR Coping[tw] OR Cranial electrotherapy stimulation[tw] OR Dental fear clinic*[tw] OR Dentist-patient relations[mh] OR Dentist-patient relation*[tw] OR Desensitization[tw] OR Desensitisation[tw] OR Desensitization, Psychologic[mh] OR Diaphragmatic breathing[tw] OR Distraction*[tw] OR Doctor patient relation*[tw] OR Education of Patient*[tw] OR EKT[tw] OR Empathy[mh] OR Empathy[tw] OR Eyeglasses[mh] OR Eyeglass*[tw] OR Eye glass*[tw] OR Filmed modeling[tw] OR Flyer*[tw] OR Focused attention[tw] OR Focussed attention[tw] OR Fragrance*[tw] OR Glasses[tw] OR Hand over mouth[tw] OR Health information[tw] OR Homeopathy[mh] OR Homeopathy[tw] OR Hypnosis[mh] OR Hypnosis, Dental[mh] OR Hypnosis[tw] OR Hypnoses[tw] OR Hypnotism[tw] OR Iatrosedation*[tw] OR Illumination[tw] OR Imaginal Flooding[tw] OR Implosive therap*[tw] OR Interview, Psychological[mh] OR Interview[tw] OR Interviews[tw]

	OR Interdisciplinary approach*[tw] OR Interpersonal communication*[tw] OR Interpersonal Relations[mh] OR Interpersonal Relation*[tw] OR Interpersonal skill*[tw] OR Laughing[tw] OR Laughter[mh] OR Laughter*[tw] OR Lighting[mh] OR Lighting[tw] OR Masking noise*[tw] OR Massage[mh] OR Massage[tw] OR Mass media[mh] OR Mass media[tw] OR "Medical personnel & patient"[tw] OR Memory[mh] OR Memory[tw] OR Mesmerism[tw] OR Modeling video*[tw] OR Motivational interviewing[tw] OR Muscle relaxation[mh] OR Music[mh] OR Music[tw] OR Music therapy[mh] OR Nonpharmacological[tw] OR Nonpharmacologically[tw] OR Odors[mh] OR Odor*[tw] OR Odour*[tw] OR Open dialogue*[tw] OR Parental involvement[tw] OR Parental presence[tw] OR PALS[tw] OR Patient education as Topic[mh] OR Patient education[tw] OR Perceived control[tw] OR Physical restraint*[tw] OR Pictorial story[tw] OR Play and Playthings[mh] OR Play and Plaything*[tw] OR Positive image*[tw] OR Preoperative information[tw] OR Preoperative education[tw] OR Perioperative information[tw] OR Preparatory information[tw] OR Printed Media[tw] OR Professional-patient relation*[tw] OR Psychological Techniques[mh] OR Psychological[tw] OR Psychologic Technique*[tw] OR Psychophysiological[tw] OR Psychosocial Support[tw] OR Psychotherapy[mh:noexp] OR Psychotherapy, Brief[mh] OR Psychotherap*[tw] OR Questionnaires[mh] OR Questionnaire*[tw] OR Reducing waiting time*[tw] OR Reinforcement (Psychology)[mh] OR Reinforcement*[tw] OR Relaxation[mh] OR Relaxation*[tw] OR Relaxing[tw] OR Restraint, Physical[mh] OR Reward[mh] OR Reward*[tw] OR Scent*[tw] OR School-based fear clinic[tw] OR Self-help treatment*[tw] OR Separate consultation*[tw] OR Simulation*[tw] OR Social Network[tw] OR Social Networks[tw] OR Social skills[mh] OR Social skill*[tw] OR Social support[mh] OR Social support[tw] OR Song*[tw] OR Special consultation*[tw] OR Spectacles[tw] OR Spectacle glasses[tw] OR Staff behavior*[tw] OR Staff behaviour*[tw] OR Stress inoculation training[tw] OR Structured telephone call*[tw] OR Sunglass*[tw] OR Sun glass*[tw] OR Tell-show-do[tw] OR Toy*[tw] OR Video clip*[tw] OR Video-taped[tw] OR Videotaped[tw] OR Video recording[mh] OR Video recording*[tw] OR Video-tape recording*[tw] OR Videotape recording*[tw] OR Video eyewear[tw] OR Virtual reality[tw] OR Voice control[tw] OR Waiting room*[tw]
#3	Adrenergic beta-Antagonists[mh] OR Adrenergic beta-Blocker*[tw] OR Adrenergic Beta-Receptor Antagonist*[tw] OR Adrenergic beta-Receptor Blockader*[tw] OR Alprazolam[mh] OR Alprazolam[tw] OR Anaesthesia[tw] OR Anesthesia[mh] OR Anesthesia, Dental[mh] OR Anesthesia[tw] OR Anesthesia, General[mh] OR Anesthetics[mh] OR Anesthetic[tw] OR Anesthetics[tw] OR Anaesthetic[tw] OR Anaesthetics[tw] OR Anti-anxiety agents[mh] OR Anti-anxiety agent*[tw] OR Anxiolytic*[tw] OR Ataractic agent*[tw] OR Barbiturates[mh] OR Barbiturate*[tw] OR Barbituric acid derivative*[tw] OR Benzodiazepines[mh] OR Benzodiazepine*[tw] OR Benzodiazepine derivative*[tw] OR Beta-Adrenergic Blocking agent*[tw] OR Beta-Adrenergic Blocker*[tw] OR Beta Adrenergic Receptor Blockader*[tw] OR Beta adrenergic receptor blocking agent*[tw] OR Bupivacaine[mh] OR Bupivacaine[tw] OR Chemotherapy[tiab] OR

	Clonazepam[tw] OR Conscious sedation[mh] OR Controlled injection pressure system[tw] OR Diazepam[tw] OR Diazemuls[tw] OR Drug[tw] OR Drugs[tw] OR Drug therapy[mh:noexp] OR Fentanyl[mh] OR Fentanyl[tw] OR Hypnotic*[tw] OR Hypnotics and Sedatives[mh] OR Ketamine[mh] OR Ketamine[tw] OR Laughing Gas[tw] OR Lorazepam[tw] OR Medication*[tw] OR Methoxyflurane[mh] OR Methoxyflurane[tw] OR Midazolam[tw] OR Narcotics[mh] OR Narcotic[tw] OR Narcotics[tw] OR Nitrous oxide[mh] OR Nitrous oxide*[tw] OR Pentobarbital[tw] OR Pharmacological[tw] OR Pharmacosedation[tw] OR Pharmacotherapy[tw] OR Pharmacotherapies[tw] OR Phenobarbital[tw] OR Phenols[mh] OR Phenol*[tw] OR Pregabalin[tw] OR Premedication*[tw] OR Propranolol[tw] OR Propofol[tw] OR Relative analgesi*[tw] OR Sedation[tw] OR Sedative*[tw] OR Sevoflurane[tw] OR Temazepam[tw] OR Tramadol[mh] OR Tramadol[tw] OR Tranquilizing Agents[mh:noexp] OR Tranquilizing Agent*[tw] OR Tranquilizer*[tw] OR Triazolam[tw] OR Valium[tw]
#4	Therapeutics[mh:noexp] OR therapy[tw] OR therapies[tw] OR treatment[tw] OR treatments[tw] OR intervention[tw] OR interventions[tw] OR manage[tw] OR management[tw]
#5	#2 OR #3 OR #4
#6	#1 AND #5
Limit to - January 2016, Humans; Languages – English, Chinese	

CINAHL

Search	Query
#1	MH Dental anxiety OR TX “Dental anxiet*” OR TX “Dental Distress” OR TX “Dental fear*” OR TX “Dental phobi*” OR TX “Dentophobi*” OR TX “Fear of dental care” OR TX “Fear of dentist*” OR TX “Fear of dentistry” OR TX “Fear of dental hygienist*” OR TX “Fear of dental therapist*” OR TX “Fear of going to the dentist*” OR TX “Odontophobi*” OR (TI dental AND (TI anxious OR TI anxiet*)) OR (AB dental AND (AB anxious OR AB anxiet*))
#2	MH Adrenergic Beta-Antagonists OR TX “Adrenergic beta-Blocker*” OR TX “Adrenergic Beta-Receptor Antagonist*” OR TX “Adrenergic beta-Receptor Blockader*” OR TX Alprazolam OR MH Anesthesia+ OR TX Anesthesia* OR TX Anaesthesia* OR MH Anesthetics+ OR TX Anesthetic* OR TX Anaesthetic* OR MH Antianxiety agents+ OR TX “Anti-anxiety agent*” OR MH Antianxiety Agents, Benzodiazepine OR TX Anxiolytic agent* OR TX Anxiolytic* OR TX “Ataractic agent*” OR MH Barbiturates OR TX Barbiturate* OR TX Benzodiazepine* OR TX “Beta-adrenergic blocking agent*” OR TX “Beta-Adrenergic Blocker*” OR TX “Beta Adrenergic Receptor Blockader*” OR TX “Beta adrenergic receptor blocking agent*” OR TX Bupivacaine OR TI Chemotherap* OR AB Chemotherap* OR TX Clonazepam OR TX “Controlled injection pressure system*” OR TX Diazepam OR TX Diazemuls OR MH Drugs OR TX Drug OR TX Drugs OR MH Drug therapy

	OR MH Fentanyl OR TX Fentanyl OR TX Hypnotic* OR MH Hypnotics and Sedatives OR TX Ketamine OR TX “Laughing Gas” OR TX Lorazepam OR TX Medication* OR TX Methoxyflurane OR TX Midazolam OR MH Narcotics OR TX Narcotic OR TX Narcotics OR TX “Nitrous oxide*” OR TX Pentobarbital OR TX Pharmacological OR TX Pharmacosedation OR TX Pharmacotherapy OR TX Pharmacotherapies OR TX Phenobarbital OR MH Phenols OR TX Phenol* OR MH Pregabalin OR TX Pregabalin OR TX Premedication* OR TX Propranolol OR TX Propofol OR TX “Relative analgesi*” OR TX Sedation OR TX Sedative* OR TX Sevoflurane OR TX Temazepam OR MH Tramadol OR TX Tramadol OR MH Tranquilizing Agents OR TX “Tranquilizing Agent*” OR TX Tranquilizer* OR TX Triazolam OR TX Valium
#3	TX therapy OR TX therapies OR TX treatment OR TX treatments OR TX intervention OR TX interventions OR TX manage OR TX management
#4	TX “3D video glasses” OR TX Acupuncture OR TX “Alternative technique*” OR MH Alternative therapies+ OR TX “Applied tension*” OR TX Aromatherap* OR TX Audio OR TX Audiorecording OR TX “ART” OR TX “Atraumatic restorative treatment” OR MH Audiovisuals+ OR TX Audiovisual* OR TX “Audio-visual*” OR TX Attire OR TX Behavioral OR TX Behavioural OR TX “Behavior control” OR TX “Behaviour control” OR TX “Behavior management” OR MH Behavior modification+ OR TX “Behavior modification*” OR TX “Behaviour modification*” OR TX Biofeedback OR TX Biopsychosocial OR MH Breathing exercises OR TX “Breathing exercise*” OR TX “Broadcast Media” OR MH Caring OR TX Caring OR TX “Chemo-mechanical caries removal” OR TX “Chemo-mechanical” OR TX “Clinical rehearsal*” OR TX “CBT” OR TX Compassion OR TX “Compliant Behavior” OR TX “Compliant Behaviour” OR MH Communication OR TX Communication OR TX “Community-based” OR TX “Computer aided self-help” OR TX Conditioning OR MH Consumer Health Information OR TX “Consumer Health Information” OR TX Cooperation OR MH Cooperative behavior OR TX “Cooperative behavior” OR TX “Cooperative behaviour” OR MH Coping OR TX Coping OR TX “Cranial electrotherapy stimulation” OR TX “Dental fear clinic*” OR MH Dentist-patient relations OR TX “Dentist-patient relation*” OR TX Desensitization OR TX Desensitisation OR TX “Diaphragmatic breathing” OR TX Distraction* OR TX “Education of Patient*” OR TX “EKT” OR MH Empathy OR TX Empathy OR MH Eyeglasses OR TX Eyeglass* OR TX “Eye glass*” OR TX “Filmed modeling” OR TX Flyer* OR TX “Focused attention” OR TX “Focussed attention” OR TX Fragrance* OR TX Glasses OR TX “Guided imagery” OR TX “Hand over mouth” OR TX “Health information” OR TX Homeopathy OR MH Hypnosis OR TX Hypnosis OR TX Hypnoses OR TX Hypnotism OR TX Iatrosedation OR TX Illumination OR TX “Imaginal Flooding” OR MH Interviews OR TX Interview* OR TX “Interdisciplinary approach*” OR TX “Interpersonal communication” OR MH Interpersonal Relations OR TX “Interpersonal Relation*” OR TX “Interpersonal skill*” OR TX Laughing OR MH Laughter OR TX Laughter OR MH Lighting OR TX Lighting OR TX “Masking noise*” OR TX Massage OR TX “Mass media” OR TX “Medical

	personnel & patient" OR MH Memory OR TX Memory OR TX Mesmerism OR TX "Modeling video*" OR MH Motivational interviewing OR TX "Motivational interviewing" OR MH Muscle relaxation OR MH Music OR TX Music OR MH Music therapy OR TX Nonpharmacological OR TX Nonpharmacologically OR MH Odors OR TX Odor* OR TX Odour* OR TX "Open dialogue*" OR TX "Parental involvement" OR TX "Parental presence" OR TX "PALS" OR MH Patient education OR TX "Patient education" OR TX "Perceived control" OR TX "Physical restraint" OR TX "Pictorial story" OR MH Play and Playthings OR TX "Play and Plaything*" OR TX "Positive image*" OR TX "Preoperative information" OR MH Preoperative education OR TX "Preoperative education" OR TX "Perioperative information" OR TX "Preparatory information" OR TX "Printed Media" OR MH Professional-patient relations OR TX "Professional-patient relation*" OR MH Psychological Techniques OR TX Psychological OR TX "Psychologic Technique*" OR TX Psychophysiological OR TX "Psychosocial Support" OR MH Psychotherapy OR TX Psychotherap* OR MH Questionnaires OR TX Questionnaire* OR TX "Reducing waiting time*" OR TX Reinforcement* OR MH Relaxation OR TX Relaxation* OR TX Relaxing OR MH Restraint, Physical OR MH Reward OR TX Reward* OR TX Scent* OR TX "School-based fear clinic" OR TX "Self-help treatment*" OR TX "Separate consultation*" OR MH Simulations OR TX Simulation* OR TX "Social Network*" OR MH Social skills OR TX "Social skill*" OR TX "Social support" OR TX Song* OR TX "Special consultation*" OR TX Spectacles OR TX "Spectacle glasses" OR TX "Staff behavior*" OR TX "Staff behaviour*" OR TX "Stress inoculation training" OR TX "Structured telephone call*" OR TX Sunglass* OR TX "Sun glass*" OR MH Support, Psychosocial OR TX "Tell-show-do" OR TX Toy* OR TX "Video clip*" OR TX Videorecording* OR TX Video-taped OR TX Videotaped OR TX "Videotape recording*" OR TX "Video-tape recording*" OR TX "Video eyewear" OR TX "Virtual reality" OR TX "Voice control" OR MH Waiting rooms OR TX "Waiting room*"
#5	#2 OR #3 OR #4
#6	#1 AND #5
Limit to - January 2016, Humans; Languages – English, Chinese	

Appendix II Appraisal instruments

JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not Applicable
1. Was the assignment to treatment groups truly random?	☐	☐	☐	☐
2. Were participants blinded to treatment allocation?	☐	☐	☐	☐
3. Was allocation to treatment groups concealed from the allocator?	☐	☐	☐	☐
4. Were the outcomes of people who withdrew described and included in the analysis?	☐	☐	☐	☐
5. Were those assessing outcomes blind to the treatment allocation?	☐	☐	☐	☐
6. Were the control and treatment groups comparable at entry?	☐	☐	☐	☐
7. Were groups treated identically other than for the named interventions	☐	☐	☐	☐
8. Were outcomes measured in the same way for all groups?	☐	☐	☐	☐
9. Were outcomes measured in a reliable way?	☐	☐	☐	☐
10. Was appropriate statistical analysis used?	☐	☐	☐	☐
	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reason for exclusion)

JBI Critical Appraisal Checklist for Experimental Studies

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

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

Overall appraisal: Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reasons for exclusion)

JBI Critical Appraisal Checklist for Comparable Cohort/ Case Control

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not Applicable
1. Is sample representative of patients in the population as a whole?	☐	☐	☐	☐
2. Are the patients at a similar point in the course of their condition/illness?	☐	☐	☐	☐
3. Has bias been minimised in relation to selection of cases and of controls?	☐	☐	☐	☐
4. Are confounding factors identified and strategies to deal with them stated?	☐	☐	☐	☐
5. Are outcomes assessed using objective criteria?	☐	☐	☐	☐
6. Was follow up carried out over a sufficient time period?	☐	☐	☐	☐
7. Were the outcomes of people who withdrew described and included in the analysis?	☐	☐	☐	☐
8. Were outcomes measured in a reliable way?	☐	☐	☐	☐
9. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reason for exclusion)

JBI Critical Appraisal Checklist for Descriptive / Case Series

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not Applicable
1. Was study based on a random or pseudo-random sample?	☐	☐	☐	☐
2. Were the criteria for inclusion in the sample clearly defined?	☐	☐	☐	☐
3. Were confounding factors identified and strategies to deal with them stated?	☐	☐	☐	☐
4. Were outcomes assessed using objective criteria?	☐	☐	☐	☐
5. If comparisons are being made, was there sufficient descriptions of the groups?	☐	☐	☐	☐
6. Was follow up carried out over a sufficient time period?	☐	☐	☐	☐
7. Were the outcomes of people who withdrew described and included in the analysis?	☐	☐	☐	☐
8. Were outcomes measured in a reliable way?	☐	☐	☐	☐
9. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

JBI QARI Critical Appraisal Checklist for Interpretive & Critical Research

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not Applicable
1. Is there congruity between the stated philosophical perspective and the research methodology?	☐	☐	☐	☐
2. Is there congruity between the research methodology and the research question or objectives?	☐	☐	☐	☐
3. Is there congruity between the research methodology and the methods used to collect data?	☐	☐	☐	☐
4. Is there congruity between the research methodology and the representation and analysis of data?	☐	☐	☐	☐
5. Is there congruity between the research methodology and the interpretation of results?	☐	☐	☐	☐
6. Is there a statement locating the researcher culturally or theoretically?	☐	☐	☐	☐
7. Is the influence of the researcher on the research, and vice- versa, addressed?	☐	☐	☐	☐
8. Are participants, and their voices, adequately represented?	☐	☐	☐	☐
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	☐	☐	☐	☐
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	☐	☐	☐	☐

Overall appraisal: ☐ Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reason for exclusion)

_____

_____

_____

JBI Critical Appraisal Checklist for Economic Evaluations

Reviewer _____ Date _____

Author _____ Year_____ Record Number _____

	Yes	No	Unclear	Not Applicable
1. Is there a well defined question?	☐	☐	☐	☐
2. Is there comprehensive description of alternatives?	☐	☐	☐	☐
3. Are all important and relevant costs and outcomes for each alternative identified?	☐	☐	☐	☐
4. Has clinical effectiveness been established?	☐	☐	☐	☐
5. Are costs and outcomes measured accurately?	☐	☐	☐	☐
6. Are costs and outcomes valued credibly?	☐	☐	☐	☐
7. Are costs and outcomes adjusted for differential timing?	☐	☐	☐	☐
8. Is there an incremental analysis of costs and consequences?	☐	☐	☐	☐
9. Were sensitivity analyses conducted to investigate uncertainty in estimates of cost or consequences?	☐	☐	☐	☐
10. Do study results include all issues of concern to users?	☐	☐	☐	☐
11. Are the results generalisable to the setting of interest in the review?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reasons for exclusion)

JBI Critical Appraisal Checklist for Narrative, Expert opinion & text

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not Applicable
1. Is the source of the opinion clearly identified?	☐	☐	☐	☐
2. Does the source of the opinion have standing in the field of expertise?	☐	☐	☐	☐
3. Are the interests of patients/clients the central focus of the opinion?	☐	☐	☐	☐
4. Is the opinion's basis in logic/ experience clearly argued?	☐	☐	☐	☐
5. Is the argument developed analytical?	☐	☐	☐	☐
6. Is there reference to the extant literature/evidence and any incongruency with it logically defended?	☐	☐	☐	☐
7. Is the opinion supported by peers?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Appendix III - Data extraction instruments

JBI Data Extraction Form for Experimental / Observational Studies

Reviewer _____ Date _____

Author _____ Year _____

Journal _____ Record Number _____

Study Method

RCT ☐ Quasi-RCT ☐ Longitudinal ☐

Retrospective ☐ Observational ☐ Other ☐

Participants

Setting _____

Population _____

Sample size

Group A _____ Group B _____

Interventions

Intervention A _____

_____

Intervention B _____

_____

Authors Conclusions:

_____

_____

_____

Reviewers Conclusions:

_____

_____

_____

Study results

Dichotomous data

Outcome	Intervention ( ) number / total number	Intervention ( ) number / total number

Continuous data

Outcome	Intervention ( ) number / total number	Intervention ( ) number / total number

JBI Data Extraction Form for Economic Evaluations

Reviewer _____ Date _____

Author _____ Year _____

Journal _____ Record Number _____

Method of Evaluation	Cost Minimisation	☐	Cost Effectiveness	☐
	Cost Utility	☐	Cost Benefit	☐

Interventions

Comparator

Setting

Geographical

Participants

Source of effectiveness data

Authors Conclusions

Reviewers Comments

Extraction Complete Yes ☐ No ☐

Clinical Effectiveness Results

Study design

Year range of primary studies

Analysis used

Clinical outcome results

Economic Effectiveness results

Date/s of economic data

Modeling used

Measure of benefits used in economic evaluation

Direct costs

Indirect costs

Currency

Statistical analysis

Estimated benefits used in EE

Cost results

Synthesis of costs and results

Outcome category

		Clinical effectiveness		
		+	0	−
Cost	+	◉ A	○ B	○ C
	0	○ D	○ E	○ F
	-	○ G	○ H	○ I

Key		
	Effectiveness	Cost
+	Better	Lower
0	Equal	Equal
-	Poorer	Higher

JBI QARI Data Extraction Form for Interpretive & Critical Research

Reviewer _____ Date _____

Author _____ Year _____

Journal _____ Record Number _____

Study Description

Methodology

Method

Phenomena of interest

Setting

Geographical

Cultural

Participants

Data analysis

Authors Conclusions

Comments

Complete Yes ☐ No ☐

Findings	Illustration from Publication (page number)	Evidence		
		Unequivocal	Credible	Unsupported

Extraction of findings complete Yes ☐ No ☐

JBI Data Extraction for Narrative, Expert opinion & text

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

Study Description

Type of Text:

Those Represented:

Stated Allegiance/ Position:

Setting

Geographical

Cultural

Logic of Argument

Data analysis

Authors Conclusions

Reviewers Comments

Data Extraction Complete Yes ☐ No ☐

Conclusions	Illustration from Publication (page number)	Evidence		
		Unequivocal	Credible	Unsupported

Include Yes ☐ No ☐

Appendix IV: List of studies excluded after critical appraisal

1. Abdeshahi SK, Hashemipour MA, Mesgarzadeh V, Payam AS, Monfared AH. Effect of hypnosis on induction of local anaesthesia, pain perception, control of haemorrhage and anxiety during extraction of third molars: A case-control study. Journal of Cranio-Maxillofacial Surgery. 2013 Jun;41(4):310-5.
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