



EFFECT OF VARIOUS DISTRACTION TECHNIQUES ON PAIN AND ANXIETY OF PEDIATRIC DENTAL PATIENTS: A SYSTEMATIC REVIEW

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ABSTRACT

Among the many behavior management techniques suggested to reduce dental pain and anxiety during treatment in children, distraction appears to be a safe and cost-effective strategy that has been proven to deliver a practical and comfortable experience throughout a quick, unpleasant dental procedure. Distraction treatment is thought to work because "the feeling of pain has a large psychological component." Using the PubMed, Medline, and ScienceDirect databases, a thorough evaluation of the literature spanning 2010 to 2022 was conducted. "Distraction tactics," "pain," "pediatric patients," and "anxiety" were the keywords chosen. Additionally, the selection procedure for the articles that were searched was described using the PRISMA flowchart. To rate the caliber of the included studies, the Cochrane risk of bias assessment approach was employed. The majority of the nine studies that were included in this systematic review, which supported the use of distraction tactics among pediatric patients, showed that they were all in favor of using them. Pediatric patients' anxiety levels can be effectively reduced during dental treatment by using distraction strategies like audiovisuals, virtual reality, and music therapy.

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Introduction

A pain-free dental experience may be achieved by "behavioral control and prevention mixed with local anesthetic procedures when necessary." Among the many behavior management techniques proposed to reduce dental pain and anxiety in children during treatment, distraction appears to be a safe and cost-effective strategy that provides a practical and comfortable experience during brief painful dental treatments [1]. For distraction therapy to be effective, it is presumed that "the experience of pain has a strong psychological component." [2] Thus, suffering is reduced when a person's attention is

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diverted from a painful stimulus. A distractor requires "a sufficient level of attention combining many sensory modalities (visual, auditory, and kinesthetic) and active emotional engagement that ensures patient participation" in order to successfully fight with signals from unpleasant stimuli [3]. A human-computer interface (HCI) is what defines virtual reality (VR), which is "basically a computer-generated environment in which the user may interact dynamically." Since virtual reality "gives more immersive graphics through the occlusive headsets that show the images directly in front of the user's eyes," it may be more effective than more traditional techniques of diversion. Depending on the kind of virtual reality headset, it may be impossible to perceive (or hear) anything outside the virtual environment. Despite the apparent benefits of virtual reality (VR) distraction in child dentistry practice, a review of the available literature found few studies examining this topic [4].

Distraction as a behavior counseling tactic is defined by the American Academy of Pediatric Dentistry (AAPD) as "the strategy of diverting the patient's attention from what may be perceived as an unpleasant activity." Dental offices have successfully used audiovisual distraction tactics to calm nervous young patients [5]. Virtual reality (VR) distraction, which can be defined as "a human-computer interface that lets the user engage interactively with the computer-generated world," is a revolutionary technology in medicine that may aid in patient behavior management. The patient, particularly a young one, may focus on the virtual experience without being distracted by the natural world. Results from dental treatments, including mild anesthetic, periodontal therapy, restorative dentistry, and pulp therapy, showed that patients of all ages benefited from distraction utilizing virtual reality [6].

Keeping one's original teeth profoundly affects one's quality of life, as it facilitates chewing, digestion, speech, aesthetics, and confidence. Therefore, oral health practitioners must practice appropriate pain treatment to reduce the prevalence of dental illness. How patients feel about and act during a dental appointment may impact their feelings and work during other types of routine medical exams. The usage of preventive medication increases and the risk of developing expensive illnesses is reduced when patients have a positive experience [7].

Materials and Methods

Using the PubMed, Medline, and ScienceDirect databases, a thorough evaluation of the literature spanning 2010 to 2022 was conducted. "Distraction tactics," "pain," "pediatric patients," and "anxiety" were the keywords chosen (**Table 1**). In addition, the PRISMA flowchart was used to describe the selection process of searched articles (**Figure 1**).

Table 1. Inclusion and exclusion criteria

No	Inclusion criteria	Exclusion criteria
1.	Case-control, randomized control studies, systematic reviews.	Expert opinions, or narrative reviews
2.	Published between 2010 and 2022	Out of the specified time range
3.	Studies include distraction techniques for anxiety control among pediatric patients.	Studies using methods other than distraction techniques for anxiety control.
4.	English language of publication	Language other than English
7.	In vivo (humans)	In vitro

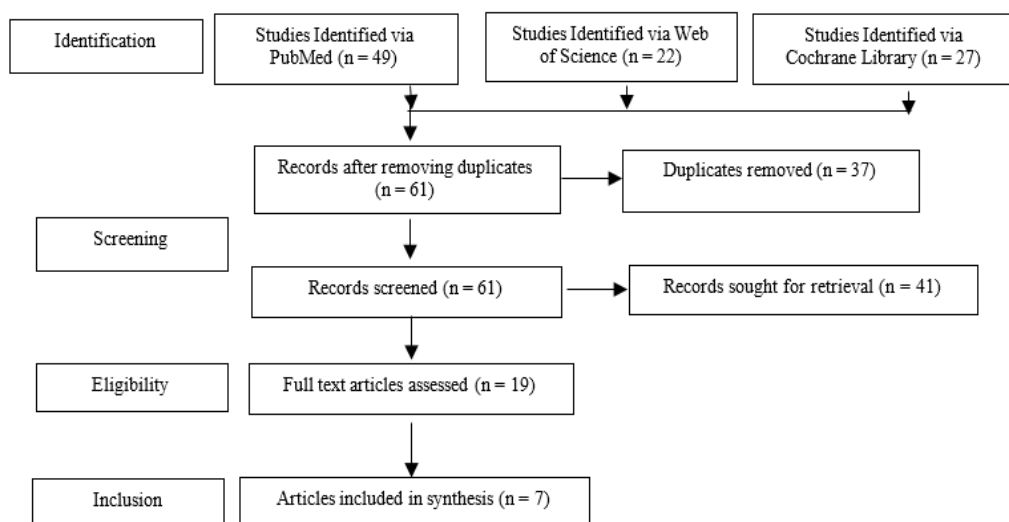


Figure 1. PRISMA Flow Diagram

Risk of Bias Assessment

The quality of the included studies was evaluated using the Cochrane risk of bias assessment technique (**Table 2**).

Table 2. Summary of Cochrane Risk of Bias Assessment

Study	Selection Bias/Appropriate control selection/baseline characteristics similarity	Selection bias in randomization	Selection bias in allocation concealment	Performance-related bias in blinding	Reporting bias/Selective reporting of outcomes	Detection bias Blinding outcome assessors	Accounting for confounding bias
Khandelwal <i>et al.</i> , 2019 [8]	+	+	+	+	+	-	+
Asokan <i>et al.</i> , 2020 [9]	+	-	-	+	+	+	+
James <i>et al.</i> , 2021 [10]	+	-	+	+	+	-	+
Pande <i>et al.</i> , 2021 [5]	+	+	-	+	+	+	+
Koticha <i>et al.</i> , 2019 [6]	+	-	+	+	-	+	+
Prado <i>et al.</i> , 2019 [11]	+	-	+	+	+	+	+
Alshatrat <i>et al.</i> , 2022 [12]	+	+	+	-	+	+	+
Felemban <i>et al.</i> , 2021 [13]	-	+	+	+	+	-	+

Results and Discussion

Table 3 shows that the research by Khandelwal *et al.*, 2019 aims to assess the relative advantages of several distraction strategies for use with young dentistry patients [8]. 80 young people in good health were selected for the study and were randomly divided into four groups of 20. Group II employed the auditory distraction technique, with Group I acting as the "control." While group IV received AVD via a television installed on the ceiling, group III received AVD via audio-visual equipment mounted on chairs. Each child made four visits to the dentist. At each visit, the child's anxiety was assessed using the Venham Picture Test (VPT), the RMS Pictorial Scale (RMS-PS), the heart rate, and the oxygen saturation. According to the findings, an AVD mounted on a chair and one fastened to the ceiling were both equally helpful at reducing anxiety. The outcomes showed that auditory distraction was the least successful strategy, although it was still better than the control scenario. The AVD approach is a straightforward, passive, and non-intrusive behavior management technique that can be applied to calm down nervous young patients for dentistry.

The study by Asokan *et al.*, 2020 evaluated 230 preschoolers for their level of anxiety using the Chotta Bheem Chutki anxiety screening scale. In a blinded, randomized, controlled study, sixty adolescents with high levels of anxiety took part [9]. A hat was used to divide them into three groups. After getting the magic ($P = 0.001$), mobile dental game ($P 0.001$), and TSD method, children's anxiety levels considerably improved ($P 0.001$). Compared to the magic and TSD groups, children in the mobility group accepted treatment more quickly.

James *et al.*, 2021 conducted the following research to assess the relative benefits of music distraction and aromatherapy with orange essential oil for calming nervous pediatric dentistry patients [10]. One hundred and fifty kids between the ages of 6 and 8 were split into three groups of 50 and given either aromatherapy, music distraction, no aromatherapy, or no music while they underwent restorative treatment. After receiving aromatherapy or music distraction, patients in both the aromatherapy and music distraction groups reported significantly lower anxiety levels on Venham's image test and the FIS. They also exhibited lower pulse and breathing rates than the control group. While music distraction performed much better than aromatherapy, the findings were not statistically significant when compared to each other. When it comes to relieving anxiety, both music distraction and aromatherapy with orange essential oil are helpful.

In their study from 2021 [5], Pande *et al.* used, sixty systemically healthy children between the ages of 8 and 10 with negative behavior that required restoration on Frankl's Rating Scale were included in the study and randomly assigned to one of four groups ($n = 15$): Tell Show Do (TSD) as a control group and audio distraction, audiovisual distraction (virtual reality [VR]), and Mobile Phone Game Distraction. Both physiological and non-physiological measures differed significantly across groups after the intervention, with the AVD (VR) group showing the greatest improvement. The most successful behavior-guiding technique for reducing dental anxiety in non-compliant kids receiving dental care, as compared to TSD alone, is AVD (VR).

The research done by Koticha *et al.*, 2019 aims to determine whether wearing virtual reality glasses may help ease the nerves of young patients having a tooth extraction [6]. 60 kids between the ages of 6 and 10 with recommended extractions for their bilaterally carious primary molars were chosen at random. In the first, there were two groups with 30 participants each: the control group and the virtual reality (VR) group. Following the extraction procedure, group I's average heart rate was 107.833 1.356, while group II's average heart rate was 108.4 0.927. When comparing heart rates between groups, a statistically significant difference was found with a p-value of 0.03. Children between the ages of 6 and 10 who were given

virtual reality as a distraction tool showed improvements in their physiological parameters. Still, the children's self-reported anxiety did not decrease as measured by Venham's image test.

The study by Prado *et al.*, 2019 aims to check whether distraction techniques (DT) can ease kids' and teens' nervousness about going to the dentist [11]. All randomized controlled studies (RCTs) involving the use of DT to treat dental anxiety or phobia in children or teenagers were included. There were a total of 20 investigations using a variety of DT modalities (audio, audiovisual, tool camouflage, biofeedback, dental operating microscope, and toys). The effectiveness of DT in reducing dental anxiety and dread may depend on various diversions, tools for measuring dental anxiety and fear, and dental procedures, according to very scant qualitative investigation.

This experimental research was done by Alshatrat *et al.*, 2022 and aimed to determine whether children had less discomfort during dental treatments while using VR [12]. Fifty-four kids between the ages of 5 and 12 were enrolled. Group A consisted of patients who planned to have non-painful dental treatments (such as fluoride therapy), and Group B consisted of patients who were scheduled to undergo painful dental operations (such as pulp therapies or tooth extractions) and required local anesthesia. For patients undergoing difficult dental operations requiring local anesthesia, both subjective and behavioral measures of pain intensity demonstrated significant decreases in pain intensity/worst pain during the dental treatment ($p=0.05$ on each). Even though the trend was as expected, patients with painless dental operations did not experience a substantial decrease in their worst pain levels when using VR. Virtual reality proved to be a useful diversion aid for children undergoing unpleasant dental operations to relieve pain and anxiety.

The kids in the research done by Felemban *et al.*, 2021 were given buccal infusion anesthetic, and the VR distraction was meant to see how much of an impact it had on their anxiety and discomfort levels [13]. Random allocation was used to place willing children between the ages of 6 and 12 who required buccal infiltration anesthesia in either the test or control groups. There were fifty people involved (mean age, 8.41.46 years). 29 participants, or the majority, were female (58.0 percent). The test group's mean heart rate was higher than the control group's at every stage except the baseline. By using multiple regression analysis, it was found that younger people and women had higher mean FLACC behavioral pain assessment scale ratings ($P = 0.034$ and $P = 0.004$, respectively), regardless of the distraction technique used. After adjusting for confounding variables, younger people and those with higher baseline resting heart rates ($P = 0.031$ and $P = 0.010$, respectively) had higher mean pain ratings on the Wong-Baker FACES scale.

Table 3. Summary of the findings

Author's name	Pediatric patients	Number of groups of pediatric patients	Objective	Results
Khandelwal <i>et al.</i> , 2019 [8]	80	4	This research compares and evaluates the efficacy of several distraction techniques in managing pediatric dentistry patients	The AVD approach is a simple, passive, and noninvasive method of behavior management that may be employed in the treatment of apprehensive young dentistry patients.
Asokan <i>et al.</i> , 2020 [9]	230	3	This study aimed to assess and compare the efficacy of two diversion tactics, a magic trick, and a mobile dental game with tell show do (TSD), in the management of nervous youngsters	There was a statistically significant difference between the three groups regarding preparedness to receive dental treatment ($P = 0.025$).
James <i>et al.</i> , 2021 [10]	150	3	To assess and contrast the effectiveness of aromatherapy with orange essential oil against music distraction in the treatment of apprehensive pediatric dentistry patients	When music distraction and aromatherapy were compared, there was no statistical significance; however, music distraction performed better than aromatherapy
Pande <i>et al.</i> , 2021 [5]	60	3	This research aims to compare and assess the efficacy of four distinct behavior-guiding strategies in managing resistant pediatric patients by evaluating before and post-operative dental fear/anxiety levels using physiological and nonphysiological factors.	A statistically significant change in physiological and nonphysiological measures was seen in the groups after the intervention, with the AVD (VR) group showing the most significant drop
Koticha <i>et al.</i> , 2019 [6]	30	2	The purpose of this research is to determine the efficacy of virtual reality eyewear as a distraction tool for children undergoing dental extraction procedures	virtual reality applied as a distraction strategy improves the physiologic parameters of children aged 6-10 years but does not diminish the patient's self-reported anxiety.

Prado <i>et al.</i> , 2019 [11]		To examine whether distraction methods (DT) minimize anxiety and dread in children and adolescents during dental treatment.	DT successfully decreased dental anxiety and dread depending on the distraction type
Alshatrat <i>et al.</i> , 2022 [12]	54	The purpose of this pilot research was to assess the effects of virtual reality (VR) on pain perception in pediatric dentistry treatments	there was no significant decrease in severe discomfort during VR
Felemban <i>et al.</i> , 2021 [13]	50	The study's goal was to see how virtual reality distraction-affected anxiety and discomfort during buccal infiltration anesthetic in pediatric patients	younger individuals and subjects with greater baseline heart rates had higher mean Wong-Baker FACES pain rating scale scores.

The results of our study's observations suggested that the RMS-PS produced a result that was statistically significant. The results revealed that, when no distraction was present, the chair-mounted AVD technique and the ceiling-mounted AVD approach lowered anxiety more than the audio distraction strategy did (control group). In the current investigation, RMS-PS and VPT both produced comparable outcomes. When compared to the auditory distraction strategy and when no distraction was utilized, the results showed that the chair-mounted AVD technique and the ceiling-mounted AVD technique reduced anxiety. When VPT was compared to audio and AVD approaches by Vishwakarma *et al.*, VPT produced unimpressive findings [14]. But research by Niharika and Atak *et al.* demonstrated that VPT was a useful indicator of the child's emotional state at a specific time [15, 16].

All three of the distraction methods were equally successful in lowering young children's anxiety by desensitizing and de-traumatizing them. The mobile dental game outperformed magic and TSD in terms of willingness to receive the treatment. Both in TSD and magic, the dentist needs to use a lot of inventiveness to avoid getting bored with the same old routine. Mobile dental games, on the other hand, give kids plenty of opportunities to get involved in a real-world scenario. More than TSD or magic, the child's interest and activity were focused on mobile gaming mechanics. In the current digital age, engaging and attractive mobile dental games can be utilized as a supplement to help kids feel less anxious. The observer is drawn away from the performer of the effect by a magic trick [17, 18]. It increases the range of behavioral options available when dealing with oppositional kids. In order to comprehend how magic works, the right hemisphere of the brain must be immediately impacted by magic tricks. Children between the ages of three and six, with a more developed right side of the brain, are naturally drawn to the magic trick and swept away into a realm of make-believe. Some kids' left brains light up when they experience magic because it sparks their imagination and makes them want to figure out how it works [19].

When compared to the controls, aromatherapy was found to be quite successful at lowering the children's anxiety levels. The aromatherapy group's anxiety reduction matched that seen in older patients awaiting dental procedures in studies by Shetty *et al.* Although future dental visits were not affected, Shetty *et al.* found that the scent of lavender reduced anxiety in patients undergoing dental procedures [2].

A patient with AD who is listening to music experiences less pain because the brainstem receives enough conflicting sensory inputs from descending pathways to signal some of the gates to close. In their study, Liu *et al.* compared AD to the TSD method and found that AD was more successful at reducing anxiety in young patients [18]. Several studies have compared AD's efficacy to that of the TSD method, and all have concluded that AD is superior at reducing fear and anxiety in young patients. Other behavior-guiding methods, such as AVD in the form of VR and television, have all been confirmed to be beneficial [20, 21] after being tested in a number of prior studies. Another study also discovered that VR distraction was superior to counter-stimulation when evaluating the effects on dental anxiety and pain perception. Today's kids are more likely to play games on their phones than ever, thanks to the widespread availability of inexpensive or even free apps. People who play games on their phones tend to zone out and miss out on other things around them [22, 23].

Research shows that people who have experienced severe pain in the past have a reduced response to distraction techniques. Due to this, participants with a dental or medical history were not included in the current study. Objective and subjective indicators of anxiety were used. Venham's image test was used to assess subjectivity. Oxygen saturation and heart rate were measured using a pulse oximeter to serve as an objective anxiety index [24]. The autonomic nerve system (ANS), which regulates the pulse rate, reflects negative emotions in physiological variables such as heart rate, breathing rate, and body temperature. As a result, ANS physiological responses can be used to determine if a person is under stress [24, 25].

However, few of the included research tested the distraction methods on people of varying ages. Thus, the exact role that age plays in the process remains unknown. It seems that patients need to take an active role in the distraction process for it to be most successful, acknowledge their terrible emotions, and reduce their anxiety by focusing on the distraction stimulus [26]. Young infants may not have the cognitive ability to pay attention for long periods of time, and some distractions (like 3D glasses, biofeedback, children's stories, a dental operating microscope, nursery rhymes, live modeling, a telescopic needle, toys, and virtual reality eyeglasses) may not be appealing to both younger and older patients. Only children were included in most studies, whereas no studies focused on teenagers [27, 28].

The results of this study lend support to the use of virtual reality distraction during routine dental operations to minimize children's perceptions of pain and fear. However, after receiving routine dental care without anesthetic, the current study observed no appreciable change in the pain rating scale-FACES and FLACC scale scores between the VR group and the non-VR group (Group A) [29]. The VAS test showed that VR considerably reduced pain for Group A. Virtual reality

headsets may reduce these worries since they prevent the customer from seeing the dentist's tools and the potentially dangerous room [30, 31].

In addition, when the VR device was on, the test group's heart rates (HR) increased significantly higher than the HR of the control group's heart rates (HR) when the screen was activated, correlating with prior research that indicated an increase in HR among VR device users. There was no statistically significant difference between the groups in the amount of HR change from baseline to the various time points, despite the test group's mean HR being higher than the control group's at numerous points during the local anesthetic treatment [1, 32].

Conclusion

Pediatric patients' anxiety levels can be effectively reduced during dental treatment by using distraction strategies like audiovisuals, virtual reality, and music therapy.

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