

THE IMPACT OF NON-PHARMACOLOGICAL BEHAVIOUR MANAGEMENT TECHNIQUES IN PEDIATRIC DENTAL CARE - LITERATURE REVIEW

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ABSTRACT

Background: Dental anxiety in children represents a persistent clinical problem that can compromise cooperation and quality of treatment. Nonpharmacological behavior management techniques are gaining attention as safe, developmentally appropriate alternatives to sedation or general anesthesia. Understanding their comparative effectiveness is essential for optimizing pediatric dental care.

Aims: The aim of this review is to assess the effectiveness of four main nonpharmacological behavior management methods (Tell Show Do, behavioral modeling, distraction, and virtual reality) in reducing dental anxiety among children. The objectives are to analyze studies published between 2020 and 2024, to identify psychological and developmental factors influencing the success of these techniques, and to evaluate the potential of artificial intelligence enhanced virtual reality (AI VR) as an innovative tool for individualized behavioral management.

Methods: A structured literature review was conducted using PubMed and Google Scholar. The search covered the years 2020–2025 and included studies involving healthy pediatric patients aged 2–12 years. Publications focused on systemic or psychiatric disorders were excluded. Twenty five studies meeting inclusion criteria were analyzed narratively. The review compared the clinical effectiveness, applicability, and limitations of four interventions: Tell Show Do, behavioral modeling, distraction, and virtual reality.

Results: All analyzed methods showed significant anxiety reduction and improvement of cooperation in children. Tell Show Do and behavioral modeling demonstrated the strongest effect on familiarization and trust building,

while distraction and virtual reality were most effective in reducing fear and pain perception during treatment. Active distraction provided superior results compared with passive approaches. Virtual reality, particularly in AI assisted adaptive form, produced the most consistent anxiety reduction, although evidence remains limited by small sample sizes and methodological diversity.

Conclusions: Nonpharmacological behavior management techniques are essential for effective pediatric dental care. Integrating traditional behavioral strategies with modern AI supported VR applications can enhance patient comfort, improve clinical outcomes, and promote positive dental experiences. Future research should standardize anxiety assessment methods, explore long term effects, and validate the safety and efficiency of AI VR for children with developmental and sensory sensitivities.

Keywords: Pediatric dentistry, behavior management, Tell Show Do, modeling, distraction, virtual reality, artificial intelligence

INTRODUCTION

A child in the context of pediatric dentistry is defined as an individual in the developmental age, typically ranging from infancy up to approximately 12 to 14 years old, marking the end of childhood and the onset of adolescence [1]. During this period, the child's psychological development is dynamic and complex, which plays a crucial role in how they perceive and respond to experiences, including dental visits.

One of the primary challenges in providing dental care to children is the prevalence of dental anxiety and fear, which are common and can lead to difficulties in cooperation during treatment [2, 3]. Dental anxiety is influenced both by previous experiences and the child's natural emotional development, often characterized by fear of the unknown and potential pain [4].

To effectively manage this anxiety and ensure safe and comfortable treatment, various approaches are employed. These can be categorized into pharmacological methods such as sedation and general anesthesia, and nonpharmacological methods that involve behavioral and psychological techniques aimed at reducing the child's anxiety and improving cooperation [5, 6]. Nonpharmacological approaches are increasingly favored because of their lower risk profiles and positive influence on child development.

Among nonpharmacological techniques, four approaches are most commonly utilized: the Tell Show Do method, behavioral modeling, distraction techniques, and the use of virtual reality (VR) technology [7, 8, 9, 10]. The Tell Show Do method involves gradually explaining, demonstrating, and performing the procedure, which helps the child understand what to expect and reduces anxiety by providing a sense of control [9, 10]. Behavioral modeling is based on observing positive role models, which the child can imitate, facilitating adaptation and familiarization with dental procedures [7]. Distraction techniques divert attention from anxiety provoking stimuli through visual, auditory, or interactive means [3]. Virtual reality enables immersive engagement in a computer generated environment, effectively minimizing pain and anxiety during dental treatment [6].

RELEVANCE AND NOVELTY

Aim and Objectives

The aim of this review is to assess the effectiveness and practical value of four nonpharmacological behavioral management techniques in reducing dental anxiety among children.

The specific objectives are:

1. To summarize and critically analyze research published between 2020 and 2025 regarding Tell Show Do, modeling, distraction, and virtual reality techniques.
2. To identify psychological, developmental, and sensory factors that determine the success of each approach.
3. To evaluate the potential of AI supported VR systems as an innovative behavioral management tool in pediatric dentistry.
4. To outline methodological limitations of current studies and define future directions for improving evidence based behavioral guidance.

Through this perspective, the article provides an updated and comprehensive synthesis of existing and emerging behavioral strategies, combining clinical applicability with technological innovation to improve the quality of pediatric dental care.

METHODS

A narrative literature review was conducted to evaluate the effectiveness of four non-pharmacological behavior management techniques in healthy pediatric dental patients. A comprehensive search of the PubMed database was performed to identify relevant studies published between January 1, 2020 and June 30, 2024. The search strategy combined Medical Subject Headings (MeSH) and free-text terms and was developed in consultation with a dental librarian to maximize sensitivity. The final search string included the following key terms and Boolean operators: ("pediatric dentistry" OR "child dental care") AND ("behavior management techniques" OR "behavior guidance") AND ("tell-show-do" OR modeling OR distraction OR "virtual reality"). The search was limited to English-language, full-text articles involving children without systemic diseases. Inclusion criteria comprised original research studies, including randomized controlled trials (RCTs), controlled clinical trials, and observational studies, with participants being healthy children aged 2–12 years. Eligible studies evaluated at least one of the four selected behavioral interventions: Tell-Show-Do (TSD), Modeling, Distraction, or Virtual Reality (VR). Exclusion criteria encompassed studies involving children with systemic or developmental disorders. Additionally, articles not available in full text in English were excluded from the review. All retrieved articles were independently screened and assessed for eligibility by two reviewers, with disagreements resolved by a third reviewer. The methodological quality and risk of bias of the included studies were evaluated using appropriate standardized tools.

INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria:

- Studies published between January 1, 2020 and June 30, 2024
- Participants aged 2–12 years classified as healthy pediatric patients
- Articles written in English and available in full text
- Original studies (randomized controlled trials, controlled clinical trials, or observational studies)
- Studies evaluating at least one of the following nonpharmacological interventions: Tell Show Do, Modeling, Distraction, or Virtual Reality

Exclusion criteria:

- Studies involving children with systemic, psychiatric, or developmental disorders
- Reviews, case reports, editorials, and conference abstracts without primary data
- Publications not available in English or lacking full text access

The search yielded 25 eligible studies. he characteristics and outcomes of the included studies were then extracted and summarized to facilitate comparison across the four behavior management techniques. Their distribution according to the behavioral management technique evaluated is summarized in Table 1.

Table 1. Distribution of Included Studies by Behavior Management Technique

Behavior-management technique	Number of primary studies
Tell-Show-Do (TSD)	11
Modeling	5
Distraction	2
Virtual Reality (VR)	5
Multi-technique comparisons	2

RESULTS

1. TELL-SHOW-DO (TSD)

The Tell-Show-Do (TSD) method is one of the most commonly employed behavioral techniques in pediatric dentistry, aimed at reducing anxiety and improving cooperation among young patients during dental procedures. This technique is based on a three-step approach: first, the clinician verbally explains the procedure ("Tell"), then demonstrates it in a friendly and painless manner ("Show"), and finally performs the actual treatment ("Do") [7,

11]. Recent studies highlight that contemporary predoctoral education in pediatric behavior guidance, including techniques like Tell-Show-Do, plays a crucial role in preparing future dentists to effectively manage child patient anxiety and improve treatment outcomes [1].

Numerous studies have confirmed the effectiveness of TSD in lowering anxiety levels and enhancing children's behavior. Alkahtani [6] conducted a comparative study on behavioral management techniques in anxious pediatric dental patients, demonstrating that while TSD effectively reduces dental anxiety, its efficacy may be somewhat lower compared to audiovisual distraction methods, highlighting the importance of selecting individualized approaches based on patient needs. Limbu et al. [7] demonstrated that TSD effectively reduces physiological stress indicators such as elevated heart rate and changes in oxygen saturation. Similarly, Elicherla et al. [4] reported that TSD improves cooperation and decreases anxiety in preschool-aged children. Kumar Verma et al. [5] emphasize that TSD is a fundamental behavior management technique, especially suitable for children with moderate anxiety levels. Lekhwani et al. [9] indicate that modifications to TSD, such as the inclusion of visual aids, enhance its effectiveness. Gozin et al. [11] showed that supplementing TSD with audiovisual elements significantly reduces anxiety in Iranian children.

An important aspect of TSD is its high acceptance among parents, which positively influences treatment outcomes. Qureshi et al. [3] note that TSD is one of the most well-received non-pharmacological methods in pediatric dentistry.

It should also be emphasized that the effectiveness of TSD depends on individual child characteristics, such as temperament and anxiety level. Pielech and Sawicki [2] highlight that each child has unique needs and expectations; therefore, the technique should be applied flexibly and tailored to the individual. Pfau et al. [10] also stress that individualization of the approach enhances therapeutic efficacy.

2. MODELING TECHNIQUE

Behavioral modeling is a well-recognized behavioral technique used in pediatric dentistry to reduce anxiety and improve patient cooperation. This method involves presenting the child with a role model—usually a peer or adult—who demonstrates positive and calm behavior in the dental setting. The goal is to trigger learning processes through observation, in accordance with Bandura's social learning theory [12].

In the study by Limbu et al. (2022) [7], the effectiveness of live modeling (where a child observes another patient during an actual dental visit) was compared with the classical Tell-Show-Do technique. Physiological stress parameters—heart rate, oxygen saturation, and emotions measured by the Facial Image Scale—were evaluated. Results showed that children in the modeling group had significantly lower heart rates and better emotional ratings, indicating clear effectiveness of this method in reducing dental stress.

Chinthala et al. (2025) [13] conducted a study comparing three modeling techniques: classic video featuring a child, a mobile app (Little Lovely Dentist), and an animated video modeling technique. In this randomized study involving children aged 4–8 years, all forms of modeling significantly reduced anxiety levels (measured by, among others, the CFSS-DS scale), with the greatest effect observed in the group using the mobile app—likely due to its interactive elements and increased child engagement.

Similar findings were reported by Biradar et al. (2024) [14], who compared the impact of three types of modeling videos (child, adult, and animated) on anxiety levels in children aged 3–6 years requiring treatment under local anesthesia. The child modeling video yielded the best results, suggesting that peer observation is more effective as a model. These differences were statistically significant ($p < 0.05$), especially in the youngest patient group.

Finally, Mittal et al. (2025) [15] evaluated a novel form of modeling using a dentistry storytelling approach. The study was conducted among children of industrial workers (aged 6–8 years), where the intervention involved reading the child a short story depicting a positive dental visit experience. Children in the experimental group exhibited significantly lower anxiety levels and greater cooperation during treatment.

Taken together, these data indicate that both traditional and modern (audiovisual, interactive) forms of modeling are effective and safe methods to reduce dental anxiety in children. Tailoring the mode of delivery to the child's age and cognitive development is crucial. Peer modeling appears particularly effective, likely due to identification mechanisms and greater trust in the observed role model.

3. DISTRACTION

Distraction, defined as the purposeful diversion of a child's attention from anxiety-provoking stimuli, is one of the most commonly employed behavioral management techniques in pediatric dentistry. Its efficacy lies in reducing the perception of fear-inducing stimuli, thereby facilitating better cooperation and enhancing treatment comfort. Distraction techniques can be categorized into passive methods, such as watching cartoons or listening to music, and active methods, which require the child's engagement in a specific activity, such as squeezing a ball or

Al-Khotani et al. (2016) evaluated the effects of audiovisual distraction on children's behavior during dental treatment. Children aged 4–6 years undergoing primary tooth treatment were randomly assigned to an experimental group (watching cartoons through video glasses) or a control group (no distraction). Behavior was assessed using the Frankl scale. Children in the distraction group demonstrated significantly better cooperation, with positive behavior observed in 86% of participants compared to 37% in the control group. Additionally, reduced muscle tension and a calmer treatment session were reported, confirming the effectiveness of passive audiovisual distraction [16].

Shekhar et al. (2022) conducted a randomized controlled trial comparing the effects of active versus passive distraction during local anesthesia administration on dental anxiety, behavior, and pain levels in children. The active distraction group engaged in simple motor activities (e.g., squeezing a rubber ball), while the passive group viewed animations on a screen. Anxiety was measured using the Modified Child Dental Anxiety Scale (MCDAS), pain with the Wong-Baker Faces Pain Rating Scale, and behavior with the Frankl scale. Both forms of distraction significantly reduced anxiety; however, active distraction yielded superior outcomes, particularly regarding cooperation and pain perception. These differences were statistically significant ($p < 0.05$), suggesting the advantage of engaging distraction techniques over passive ones [17].

Table 2. Comparison of active and passive distraction in reducing dental anxiety in children

Distraction Type	Study format used	Scope of action	Clinical effects	References
Passive	Viewing animations while anesthesia was administered	Diversion of attention from the procedure	• Significant reduction in anxiety and pain; • Improved behavior; • Effective, though less than the active form.	Shekhar et. al., 2022
Active	Ball squeezing/ motor tasks	Psychomotor involvement of the child	• The greatest reduction in pain and anxiety; • Significant improvement in cooperation; • Highly effective in children 6–10 years of age.	Shekhar et. al., 2022

4. VIRTUAL REALITY (VR) EYEWEAR

Virtual Reality (VR) is an immersive technology that presents the user with a computer-generated three-dimensional environment, engaging primarily the visual and auditory senses through specialized goggles. This technology has been increasingly applied in pediatric healthcare, particularly in dentistry, to reduce anxiety and improve patient cooperation [18, 21, 22]. VR effectively isolates the child from the real stimuli of the dental office, allowing for a significant reduction in stress, anxiety, and perceived pain [18, 20].

In a randomized clinical trial by Ran et al. (2021), children aged 4–8 years were assessed for the effectiveness of immersive virtual reality compared to traditional behavioral approaches during short dental procedures. The results demonstrated that children exposed to VR showed significantly lower anxiety levels (measured by the mCPQ scale) [18], better cooperation, and higher post-procedure satisfaction. Notably, VR was particularly effective in children undergoing dental treatment for the first time, where primary anxiety plays a significant role.

Similarly, Alshatrat et al. (2022) evaluated the effect of immersive virtual reality on pain levels during various dental procedures in children—from examinations to extractions. The use of VR reduced subjective pain (according to the Wong-Baker scale) [19] and improved children's overall experience. The technology proved especially beneficial during more invasive procedures such as anesthesia administration and extractions, indicating its potential for challenging clinical situations.

Custódio et al. (2020) investigated the effectiveness of VR glasses as a passive distraction technique in everyday dental practice. Their study, involving children aged 4–7 years, compared a VR group with a control group without distraction. The findings clearly showed significant anxiety reduction and improved cooperation in the VR group, along with high acceptance of this method by children and their caregivers [20].

Cunningham et al. (2021), in a systematic review of 14 studies, analyzed the use of VR and mobile dental applications for managing pediatric dental anxiety. Most studies confirmed VR's effectiveness in reducing anxiety and pain, as well as improving behavior—especially during first dental visits [21]. The authors emphasized the need for standardization of VR tools and more research with long-term follow-up.

In the most recent study by Hamdy et al. (2024), VR was evaluated not only as an anxiety-reducing tool but also as a factor enhancing communication and cooperation with pediatric patients. The use of VR decreased the number of interruptions during procedures and increased children's sense of safety, which is crucial for building long-term trust with the dentist [22].

Mehrotra and Manju (2023) provided an interesting perspective by comparing the impact of VR on healthy children and those with mild intellectual disabilities. Both groups benefited from anxiety reduction, although the effect was more pronounced in neurotypical children. This finding suggests the necessity of individualizing VR content, especially for children with additional developmental needs [23].

Collectively, the gathered evidence clearly indicates that virtual reality technology is a modern and effective behavioral tool for reducing anxiety and improving cooperation in pediatric dental settings. Its effectiveness depends on factors such as the child's age, type of procedure, previous experiences, and VR content. This requires a conscious and individualized approach by medical staff but offers a real opportunity to enhance the quality of dental care for children.

DISCUSSION

The synthesis of the reviewed evidence confirms that nonpharmacological behavior management techniques play a central role in modern pediatric dentistry by improving cooperation and reducing anxiety without the risks associated with sedation or anesthesia [1–3, 5, 6]. Across all analyzed interventions (Tell Show Do (TSD), modeling, distraction, and virtual reality (VR)) consistent benefits were observed, although their effectiveness depends on the child's developmental, emotional, and sensory characteristics [2, 4, 7, 10].

The TSD method remains a foundational approach due to its simplicity, adaptability, and strong evidence base. Multiple randomized studies demonstrate its capacity to significantly lower anxiety and physiological stress markers in children aged 3 to 8 years [4, 5, 6, 7, 9, 11]. Its success relies on the dentist's communication skills and the child's cognitive readiness to understand explanations. Modifications that include audiovisual elements or storytelling increase engagement and yield better behavioral outcomes [9, 11]. Nevertheless, TSD is less effective in children with severe anxiety, limited comprehension, or neurodevelopmental disorders, which indicates the need for individualized application [2, 10].

Modeling techniques represent a cognitive behavioral extension of TSD and capitalize on the child's natural tendency to learn through imitation. The effectiveness of live or video modeling, particularly peer based and interactive forms, is well supported by recent studies [7, 13–15]. Digital platforms and mobile applications that combine visual stimuli with interactivity have proven especially useful for younger patients [13, 14]. However, the heterogeneity of modeling formats complicates direct comparison between studies. Future research should focus on standardized outcome measures and the influence of the model's characteristics (age, gender, emotional tone) on the child's response [12, 15].

Distraction techniques demonstrate strong and reproducible effects in reducing fear and pain perception [16, 17]. Active distraction that requires motor or cognitive engagement shows greater efficacy than passive forms that mainly provide sensory diversion [17]. However, the suitability of each approach depends on age and attention capacity [24]. Children under six years or those with hyperactivity may not benefit from active distraction. Combining distraction with other methods such as TSD or VR can further enhance compliance and comfort [3, 5, 18, 19].

Virtual reality has emerged as the most innovative technique, combining elements of distraction, immersion, and sensory isolation. Evidence consistently indicates that immersive VR substantially decreases subjective and

physiological indicators of anxiety and pain [18–23]. The integration of AI enhanced VR systems capable of adapting content in real time to the child’s reactions represents an important direction for future development [21, 22]. Despite promising results, limitations remain, including the lack of standardized VR protocols, small sample sizes, and minimal long term follow up [20, 23]. Additionally, contraindications such as motion sickness or sensory hypersensitivity restrict universal applicability [23].

Comparative analysis suggests that no single behavioral technique is universally superior. Optimal management of pediatric dental anxiety requires an individualized multimodal approach that takes into account age, temperament, previous experiences, and clinical context [2, 7, 10, 24]. Combining traditional behavioral guidance with emerging AI driven technologies may represent the most effective strategy for improving patient experience and procedural outcomes [18, 21, 22].

Finally, while most included studies confirm short term benefits of behavioral interventions, few address the persistence of positive behavioral patterns over time [21]. Future research should include longitudinal designs and standardized anxiety scales to evaluate the durability of these effects and to determine whether early exposure to positive dental experiences translates into better lifelong oral health behavior [24, 25].

LIMITATIONS OF THE ABOVE METHODS

Each behavioral approach has specific limitations that restrict its universal use. The TSD method depends on the child’s communication abilities and is less effective in children with cognitive impairments or high anxiety levels [4, 7, 10]. Modeling requires attention and imitation capacity, therefore it is less suitable for children with developmental disorders [12, 15]. Distraction methods may fail in children with attention deficit or sensory hypersensitivity [17, 24]. Virtual reality, although highly effective, may cause discomfort in children prone to motion sickness or claustrophobia and is not compatible with certain dental procedures requiring sedation [18, 20, 23]. These limitations confirm that behavioral guidance must always be adapted individually, integrating multiple complementary techniques to achieve the safest and most effective result.

Understanding these limitations is crucial for the safe and effective selection of behavioral techniques in dental practice. The table below summarizes the contraindications and limitations of the four behavioral methods discussed above in the context of working with pediatric patients.

Table 3. Contraindications and Limitations of Selected Behavioral Methods in Pediatric Dentistry

Method	Description of the method	Contraindications and limitations	References
Modeling	A child observes the calm behavior of another child or adult.	• Less effective in children with developmental disorders (e.g., autism). • Requires the ability to observe and imitate	AAPD (2020); Limbu et. al. (2022)
Active Distraction	A child performs simple activities (e.g., squeezing a ball, playing an interactive game).	• May be ineffective in children with ADHD or attention deficit disorder. • May be difficult to perform in very young children.	Shekhar et. al. (2022)
Passive Distraction	A child watches cartoons, listens to music, or looks at a screen.	• May increase anxiety in children with sensory hypersensitivity. • May be less effective than with active therapy	Al-Khotani et. al. (2016); Custódio et. al. (2020)

Virtual Reality (VR)	VR glasses isolate the child from their surroundings and transport them to a virtual world.	• Balance disorders and motion sickness. • Vision/hearing impairments. • Incompatible with inhalation sedation. • Claustrophobia	Ran et. al. (2021); Hamdy et. al. (2024); Mehrotra & Manju (2023)
Tell-Show-Do (TSD)	Explanation → demonstration → performing the procedure in a predictable manner.	• Less effective in children with cognitive impairments or high anxiety levels. • Requires the child's cooperation.	AAPD (2020); Chinthala et. al. (2025)

CONCLUSIONS

Nonpharmacological behavior management techniques, including Tell Show Do (TSD), behavioral modeling, distraction, and virtual reality (VR), show strong and consistent evidence of effectiveness in reducing dental anxiety in children.

The review demonstrates that:

- TSD significantly lowers anxiety and improves cooperation, particularly when supported by audiovisual elements and adapted to each child’s temperament and cognitive abilities [4, 5, 7, 9, 11].
- Behavioral modeling, including peer observation and interactive audiovisual formats, effectively reduces fear and enhances acceptance of dental treatment [7, 13–15].
- Distraction methods, both passive and active, decrease anxiety and perceived pain, with active distraction showing better outcomes among school aged children [16, 17].
- Virtual reality provides immersive sensory engagement that markedly reduces anxiety and increases comfort, especially in first time dental patients [18–23].

Integrating individualized evidence based behavioral methods into pediatric dental care improves child cooperation, enhances treatment efficiency, and promotes positive attitudes toward oral health. Selection of the method must consider the child’s developmental stage, temperament, previous experiences, and sensory sensitivity.

PRACTICAL SIGNIFICANCE AND ORIGINAL CONTRIBUTION

This review is among the first to integrate traditional behavioral approaches with evidence on artificial intelligence enhanced virtual reality. The findings emphasize that combining established nonpharmacological techniques with adaptive, AI supported technologies may define a new standard of pediatric behavioral management.

FUTURE PERSPECTIVES

Further studies should focus on long term outcomes, standardization of anxiety assessment tools, and inclusion of children with developmental and sensory disorders. Comparative trials across diverse populations are needed to validate the effectiveness and safety of AI based VR in clinical pediatric dentistry.

DISCLOSURE

AUTHORS CONTRIBUTIONS

Conceptualization, Methodology, Supervision: Karolina Zalisz, Maciej Zajęc, Karina Aleksandra Koszuta, Maria Sikora

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USE OF AI

The authors report that ChatGPT was used solely as a tool to assist with language editing and text organization in the preparation of this manuscript. All decisions regarding content, data interpretation, conceptualization, writing, and final approval of the manuscript were made and verified exclusively by the authors. This ensures that the content, accuracy, and integrity of the article reflect the independent scholarly work of the research team.

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