
Behavior Management Using Arithmetic Puzzle Distraction During Primary Tooth Pulpotomy: A Case Report Of A 10-Year-Old Child

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Abstract

Behavior management is a crucial component in the success of pediatric dental care. Distraction as a non-pharmacological technique plays an important role in reducing anxiety and improving patient cooperation. Arithmetic puzzles represent an active form of distraction that engages children's cognitive abilities; however, their application in invasive procedures such as pulpotomy has rarely been reported. A 10-year-old boy presented with dental caries in the mandibular right primary second molar (tooth 85) and was planned for pulpotomy treatment. The patient exhibited dental anxiety toward dental procedures, requiring a behavior management approach. Behavior management was implemented using a combination of Tell-Show-Do, desensitization, active distraction with an arithmetic puzzle, and positive reinforcement at each visit. After the patient adapted to the clinical environment and demonstrated improved cooperation, conventional pulpotomy was performed according to clinical standards, followed by temporary restoration. Consistent application of behavior management techniques improved communication, built patient trust, reduced anxiety, and enhanced cooperation throughout treatment. The arithmetic puzzle served as an active distraction by engaging cognitive processes appropriate for the developmental stage of school-aged children, thereby shifting attention away from dental procedures. The arithmetic puzzle has potential as a simple, cost-effective, and practical distraction method to improve pediatric patient cooperation during dental treatment. Further studies with larger sample sizes and standardized behavioral assessment tools are required to objectively evaluate its effectiveness.

Keywords: Behavior Management, Distraction, Pulpotomy, Arithmetic Puzzle

INTRODUCTION

The success of pediatric dental care is determined not only by the clinical skills of the operator, but also by the ability to implement effective behavioral management to reduce anxiety and improve patient cooperation. Dental anxiety is one of the main challenges in children's dentistry practice because it can affect acceptance of actions, increase uncooperative behavior, and hinder the smooth running of treatment procedures. This condition can be caused by previous negative experiences, fear of pain, unfamiliar clinical environment, and a child's lack of understanding of dental procedures. The American Academy of Pediatric Dentistry (AAPD, 2025) emphasizes that behavior management is a continuous approach that aims to build effective communication, reduce anxiety, increase trust, and form a positive care experience in children.

The Behavioral Guidance for the Pediatric Dental Patient and the Nonpharmacological Behavior Guidance for the Pediatric Dental Patient recommend a variety of nonpharmacological techniques as a first line before considering pharmacological approaches, such as sedation or general anesthesia. These techniques include Tell-Show-Do, modeling, desensitization, positive reinforcement, and distraction, which are selected according to the patient's age, developmental level, experience, and individual needs. The combination of several nonpharmacological techniques is considered more effective in improving cooperative behavior and reducing anxiety than using one technique alone (American Academy of Pediatric Dentistry, 2025; Dhar et al., 2023a, 2023).

Distraction is one of the behavior management techniques that works by diverting the patient's attention from the stimulus that causes anxiety or discomfort to other activities that are more interesting so that the perception of pain and treatment procedures can be reduced. Various forms of distraction have been developed in clinical practice, including audiovisual distractions, virtual reality, music, digital games, and interactive activities. Several systematic reviews show that distractions,

especially audiovisual distractions and active distractions, are significantly able to lower anxiety levels, reduce pain perception, and improve children's cooperation during dental care (Dahlan et al., 2023; Padilha et al., 2023; Dhar et al., 2023b).

In addition to reducing anxiety during treatment, effective behavior guidance plays an important role in shaping children's long-term attitudes toward dental care. Positive early dental experiences help children develop trust in dental professionals, increase their willingness to attend future appointments, and promote better oral health behaviors throughout life. Conversely, negative or traumatic experiences may result in persistent dental fear, avoidance of dental visits, and poorer oral health outcomes. Therefore, behavior guidance should be regarded as an integral component of pediatric dental treatment rather than merely a supportive adjunct to clinical procedures (Cianetti et al., 2017; Casamassimo et al., 2019; Dean, 2022; American Academy of Pediatric Dentistry, 2025).

One form of active distraction that has the potential to be used is the arithmetic puzzle. This educational game involves the ability to calculate, logical reasoning, and simple problem solving so that it is able to maintain the child's cognitive involvement during the procedure. Based on Piaget's (1969) theory of cognitive development, children aged 7–11 years are at a concrete operational stage so that they are able to think logically about concrete objects and problems. In addition to being easily adapted to these developmental stages, arithmetic puzzles have the advantage of being simple, economical, do not require electronic devices, and are easy to apply in daily clinical practice. However, scientific evidence regarding the use of arithmetic puzzles as a distraction medium in invasive procedures, such as first-tooth pulpotomy, is still very limited, so case reporting and further research are still needed (Elheeny, 2021; Dahlan et al., 2023).

Pulpotomy is one of the most frequently performed vital pulp therapies for primary teeth with deep carious lesions and commonly involves local anesthesia, caries excavation, and pulp tissue removal. These procedures may provoke fear and anxiety in pediatric patients, making patient cooperation a key determinant of treatment success. Consequently, the implementation of effective nonpharmacological behavior guidance during pulpotomy is essential to facilitate clinical procedures, minimize patient distress, and enhance the overall treatment experience (American Academy of Pediatric Dentistry, 2025; Wright & Kupietzky, 2021; Dean, 2022).

Among the available nonpharmacological approaches, active distraction techniques have attracted increasing attention because they require children to engage cognitively rather than passively receiving sensory stimulation. By directing the child's attention toward problem-solving activities, active distraction may reduce the cognitive resources available for processing pain and anxiety-provoking stimuli. Previous studies have demonstrated that active distraction can effectively reduce dental anxiety and improve cooperative behavior during invasive dental procedures; however, evidence specifically evaluating arithmetic puzzles remains limited, highlighting the need for additional clinical reports and further investigation (Collado et al., 2017; Elheeny, 2021; Dahlan et al., 2023).

This case report presents a 10-year-old boy with deep caries in the eldest molar tooth of the right mandible undergoing pulpotomy treatment using a combination of nonpharmacological behavior management techniques, including active distraction with arithmetic puzzles, with the aim of describing the application of the technique in improving patient cooperation during the treatment series.

RESEARCH METHODS

This study is a case report with an observational descriptive approach on one pediatric patient undergoing dental treatment at Soelastri Dental and Oral Hospital. This case report was compiled to illustrate the application of nonpharmacological behavior management using arithmetic puzzle distractions during pulpotomy procedures on eldest molar teeth. A 10-year-old male patient who came in with a complaint of caries in the eldest molar tooth of the right mandible. The diagnosis is

established based on an anamnesis, clinical examination, and radiographic supporting examination. The treatment carried out is a conventional pulpotomy on the first molar teeth. All procedures are performed according to the standard operating procedures of clinical procedures, including local anesthesia, caries excavation, coronal pulp amputation, medication with formocresol, zinc oxide eugenol base application, and temporary restoration. Behavior management was carried out nonpharmacologically at each visit using a combination of *Tell-show-do*, *Desensitization*, *Active distraction* techniques using arithmetic puzzles, *Positive reinforcement*. Arithmetic puzzles are used as an active distraction medium during the action to distract the patient from the clinical procedure. Evaluation of patient behavior is carried out descriptively at each visit based on the patient's ability to follow the operator's instructions, response to clinical actions, level of cooperation during procedures compliance with the treatment schedule. Behavioral changes were observed longitudinally over the entire series of visits without the use of formal scoring instruments, but referred to clinical cooperative behavior criteria. This study has obtained informed consent from the patient's parents/guardians before treatment. The patient's identity is kept confidential in accordance with the ethical principles of dentistry. All actions are carried out in accordance with professional ethical standards and clinical guidelines applicable at Soelastris Dental and Oral Hospital.

RESULTS AND DISCUSSION

Case Report

A 10-year-old boy came with his guardian to Soelastris Dental and Oral Hospital with the main complaint of cavities in the posterior region of the right mandible. Complaints have been felt since ± 6 months before, accompanied by spontaneous pain that arises after the consumption of sugary foods or drinks. The patient has a history of temporary treatment in the form of patching at a primary health care facility and administering analgesic drugs. There is no history of systemic disease or drug allergy reported by the patient or the patient's guardian. An extraoral examination showed that there were no abnormalities in the face or surrounding tissues. Intraoral examination showed tooth 85 (right mandibular eldest molar) with cavities in the distoklusal area extending to near the pulp chamber. No swelling, fistulas, or signs of inflammation of the periapical tissue were found. Objective examination showed the results of the survey (+), percussion (-), palpation (-), mobility degree 0, and the results of the Electric Pulp Test (EPT) showed a positive response with a value of 19.

Based on the results of the anamnesis, clinical examination, and supporting examinations, a diagnosis of profound caries with the involvement of vital pulp (reversible pulpitis) was established in 85 teeth. The treatment plan carried out was a conventional pulpotomy to maintain the vitality of the radicular pulp, followed by pulp mediation and temporary restoration. The prognosis of the case is assessed well based on the condition of the pulp that is still vital, the absence of signs of periapical tissue involvement, and the patient's ability to adapt to the treatment procedure. During the treatment procedure, patients show an improvement in cooperative behavior after the application of nonpharmacological behavior management techniques, so that the entire pulpotomy stage can be performed without intraoperative complications. The initial success of treatment is characterized by the completion of the procedure as planned and the patient's good response to the operator's instructions.

Case Management

The first visit was made on May 6, 2026 by establishing initial communication between the operator, the patient, and the patient's parents. An anamnesis, extraoral and intraoral examinations, caries risk assessment, dietary analysis, and *oral hygiene instruction* (OHI) were carried out. At this stage, nonpharmacological behavior management is applied using a combination of *tell-show-do* techniques, *modeling*, *desensitization*, *distraction*, and *positive reinforcement*. The *tell-show-do* technique is used to gradually introduce treatment tools and procedures. *Modeling* and *desensitization* are carried out so that the patient is familiar with the clinical environment and dental procedures. As

an active distraction medium, the patient uses an arithmetic puzzle that he or she brings with him at each visit. Puzzles are played before and during the action when the patient begins to show signs of boredom or loss of attention. On several occasions, patients also use their parents' gadgets as an additional distraction medium for a limited time.

Every cooperative behavior, such as following the operator's instructions and opening his mouth according to the instructions, is given *positive reinforcement* in the form of verbal praise and appreciation. The application of these techniques is carried out consistently at each visit until the patient is able to adapt to the clinical environment and show good cooperation. After the patient shows cooperative behavior, a panoramic radiography examination is performed to support diagnosis enforcement and treatment planning. Furthermore, conventional pulpotomy was performed on 85 teeth according to clinical procedures, including local anesthesia, caries tissue excavation, coronal pulp amputation, irrigation using 0.9% physiological NaCl, bleeding control, application of formochorsol for ± 5 minutes, placement of zinc oxide eugenol (ZOE), application of glass ionomer cement (GIC) type III as lining, and temporary restoration using Cavit.

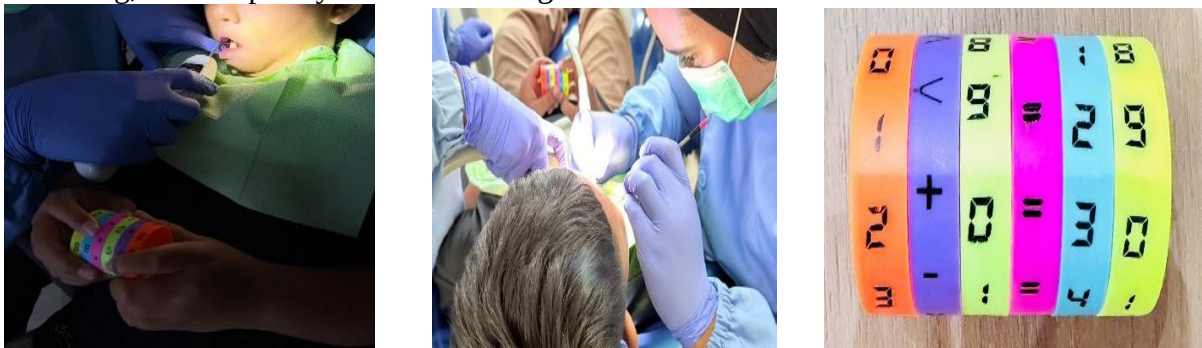
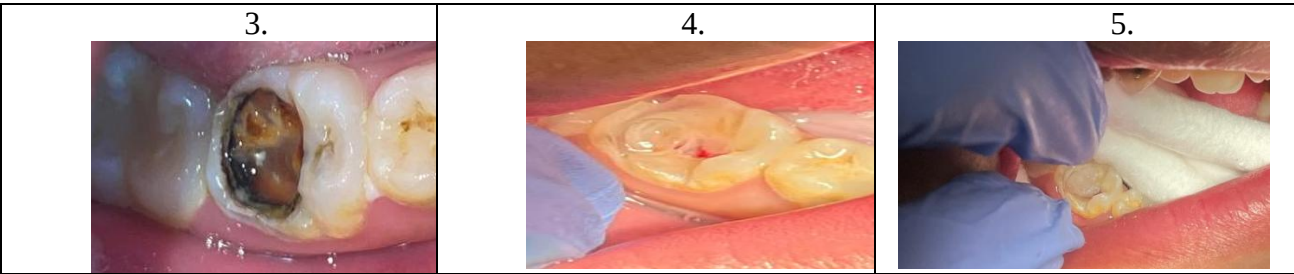


Figure 1. (A,B,C) The application of behavior management uses arithmetic puzzle distractions during the adaptation visit.



Figure 2. (A,B) Panoramic radiography examination after the patient is cooperative.



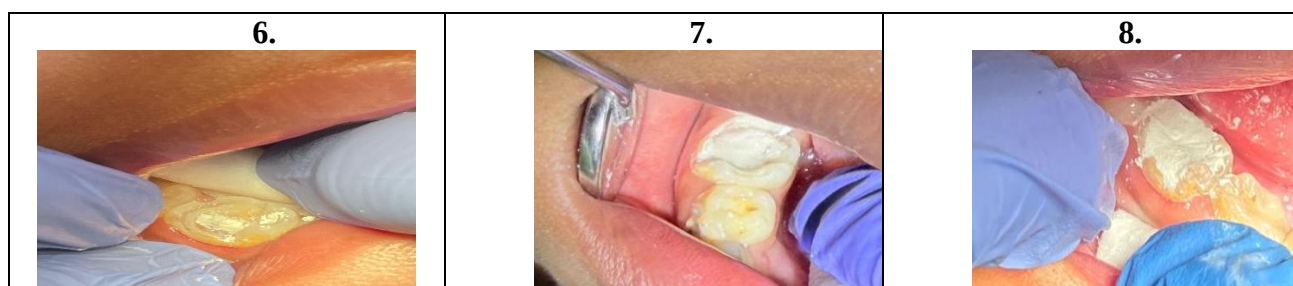


Figure 3–8. Stages of pulpotomy treatment in teeth 85.

Figure 3. The initial image of the tooth that will be treated pulpotomy at the first visit after obtaining approval from the patient's parents, a pulpotomy was performed on tooth 85. Local anesthesia is administered until adequate anesthesia is achieved. Furthermore, the isolation of the work area and the excavation of caries tissue thoroughly were carried out using low-speed bur and excavators until all infected dentins were lifted. **Figure 4.** Cleaning caries using a round bur and an excavator. The roof of the pulp chamber is then opened to obtain adequate access to the pulp network. The coronal pulp tissue is amputated using a sterile excavator until healthy radicular pulp remains. The cavity was then irrigated using a sterile saline solution (NaCl 0.9%) to remove residual debris and pulp tissue. **Figure 5.** Bleeding is controlled using sterile cotton pellets. Bleeding is controlled using a sterile cotton pellet that is lightly pressed on the orifice of the root canal until hemostasis is achieved. After controlled bleeding, the application of formocoresol was carried out on sterile cotton pellets placed on the orifice of the root canal for ± 5 minutes as a fixation material for the radicular pulp. **Figure 6.** Mediation of zinc oxide and eugenol paste in the pulp chamber **Figure 7.** Apply glass ionomer cement (GIC) type III as a lining. After the cotton pellets containing formocoresol are removed, the bottom of the pulp chamber is closed using zinc oxide eugenol (ZOE) as a medicine. Furthermore, glass ionomer cement (GIC) type III was applied as a coating material on top of ZOE. **Figure 8.** The cavity is closed using temporary restoration material. Sterile Cotton pellets are then placed on top of the layer, and the cavity is closed using temporary restoration materials of the cavity. The patient is scheduled for a subsequent visit for clinical evaluation and definitive treatment.

Discussion

Behavior management is an important component of the success of pediatric dental care, especially in patients who require repeated treatment. The success of treatment is determined not only by the patient's clinical condition, but also by the operator's ability to establish effective communication, reduce anxiety, as well as increase patient cooperation during the procedure. In this case, the nonpharmacological behavior management approach was applied consistently from the first visit to the last visit so that it was able to gradually increase the patient's level of cooperation.

This finding is consistent with the recommendations of the American Academy of Pediatric Dentistry (AAPD), which emphasizes that behavior guidance should be regarded as a continuous process rather than a single intervention. Building trust through repeated positive experiences enables children to become more familiar with the dental environment and gradually increases their willingness to cooperate during subsequent appointments. Similar observations have been reported in pediatric dentistry literature, indicating that consistent application of evidence-based behavior guidance techniques can improve patient acceptance of dental treatment while reducing the need for pharmacological approaches (American Academy of Pediatric Dentistry, 2025; Wright & Kupietzky, 2021).

Another important aspect observed in this case was the progressive improvement in the patient's behavior across multiple treatment visits. Children's behavioral responses are dynamic and may change according to previous dental experiences. A positive experience during the initial appointment often reduces anticipatory anxiety before future visits, allowing children to become increasingly cooperative over time. This gradual adaptation highlights the importance of providing positive dental experiences from the beginning of treatment because each successful visit contributes to improving

the child's confidence in future dental care (American Academy of Pediatric Dentistry, 2025; Wright & Kupietzky, 2021).

Patients aged 10 years have been cognitively developed to understand simple instructions and think logically according to concrete operational stages. Therefore, the use of the tell-show-do technique is effective because the patient can understand the explanation of the procedure before the procedure is performed. This approach helps reduce uncertainty about the tools and procedures so that the patient's anxiety gradually decreases. In addition, desensitization techniques through the gradual introduction of tools and procedures provide an opportunity for patients to adapt to the clinical environment without feeling threatened.

The effectiveness of the Tell-Show-Do technique in this case can also be explained by Piaget's theory of cognitive development. Children aged 7–11 years are in the concrete operational stage, during which they are able to understand logical explanations related to tangible objects and sequential events. Consequently, explaining and demonstrating the dental instruments before use helps reduce uncertainty and provides the child with a greater sense of predictability and control during treatment. This interpretation is consistent with previous evidence identifying Tell-Show-Do as one of the most effective first-line behavior guidance techniques in pediatric dentistry (Piaget, 1969; Dean, 2022; Dhar et al., 2023).

Distraction is a technique that contributes greatly to the success of treatment in this case. The use of arithmetic puzzles brought by patients themselves has been proven to be able to distract from stimuli that have the potential to cause anxiety. Compared to passive distractions such as watching videos, puzzles involve active cognitive activity so that the patient's attention is more focused on the game than the treatment procedure. Although the patient occasionally asks to use his mother's gadget, the frequency is still within reasonable limits and does not interfere with the course of treatment. This shows that the use of distraction media that suits the child's interests can be an effective alternative in improving patient comfort during the procedure.

The successful use of arithmetic puzzles in this case is consistent with previous studies demonstrating that active distraction effectively reduces anxiety by engaging children's attention in cognitively demanding tasks. Unlike passive distraction methods, arithmetic puzzles require sustained concentration, logical reasoning, and continuous problem-solving, thereby limiting the attentional resources available for processing painful or anxiety-provoking stimuli. This mechanism is supported by cognitive theories suggesting that pain perception decreases when attention is allocated to competing cognitive tasks (Collado et al., 2017; Elheeny, 2021; Dahlan et al., 2023).

The patient's willingness to repeatedly use the arithmetic puzzle also reflects the importance of selecting distraction media that match the child's interests and preferences. Allowing children to engage with a familiar and enjoyable activity may increase their sense of autonomy and perceived control during treatment, both of which are recognized as factors that reduce dental anxiety. Child-centered behavior guidance strategies that actively involve patients in coping with dental procedures have been associated with improved cooperation and more positive treatment experiences (Collado et al., 2017; Dhar et al., 2023).

Another noteworthy observation is that the arithmetic puzzle did not interfere with communication between the dentist and the patient. Despite actively solving the puzzle, the patient remained responsive to verbal instructions and was able to follow treatment commands appropriately. This balance between cognitive engagement and communication is particularly important during invasive dental procedures, where continuous interaction between the clinician and patient is essential for safe and effective treatment (Dean, 2022; Wright & Kupietzky, 2021).

Compared with technology-based distraction methods such as audiovisual media or virtual reality, arithmetic puzzles offer several practical advantages. They are inexpensive, portable, reusable, require no electronic devices or internet access, and can easily be implemented in routine clinical practice. These characteristics make arithmetic puzzles particularly suitable for community dental

clinics and healthcare facilities with limited resources while still providing the benefits of active cognitive distraction (Padilha et al., 2023; Dahlan et al., 2023).

Providing positive reinforcement in the form of verbal praise whenever the patient is able to follow instructions also plays a role in shaping a positive experience during treatment. Positive reinforcement increases the patient's motivation to maintain cooperative behavior at the next visit. The consistency of the operator in applying behavior management techniques at each visit helps build a relationship of mutual trust (dentist-patient rapport) so that patients become more comfortable in the clinic environment.

The favorable outcome observed in this case was most likely not attributable to a single behavior guidance technique but rather to the combination of several complementary nonpharmacological strategies. Tell-Show-Do reduced uncertainty, desensitization facilitated gradual adaptation, arithmetic puzzles diverted attention from anxiety-provoking stimuli, and positive reinforcement strengthened desirable behaviors. Systematic reviews have suggested that combining multiple behavior guidance techniques generally produces greater improvements in children's cooperation than relying on a single intervention because different techniques address different psychological aspects of dental anxiety (American Academy of Pediatric Dentistry, 2025; Dhar et al., 2023).

The success of behavior management in this case is also supported by parental involvement. The presence of the patient's mother during the treatment provides a sense of security and helps maintain the patient's adherence to the visit schedule. Family support is one of the factors that affect the success of behavior modification because it can reinforce the positive experiences that patients have during treatment.

Parental involvement has also been recognized as an important component of successful pediatric dental care. Parents who provide reassurance and encourage children to attend scheduled appointments contribute to the development of positive attitudes toward dental treatment. In this case, the mother's consistent support likely reinforced the patient's confidence and facilitated continued cooperation throughout the treatment process. Such findings are in accordance with current recommendations emphasizing collaborative partnerships between dental professionals, patients, and caregivers during pediatric dental care (American Academy of Pediatric Dentistry, 2025; Dean, 2022).

Overall, this case demonstrates that integrating Tell-Show-Do, desensitization, active distraction using arithmetic puzzles, positive reinforcement, and parental support can successfully facilitate pulpotomy treatment in a school-aged child. The patient's progressive improvement in cooperation throughout multiple visits suggests that arithmetic puzzles may serve as a useful adjunct to established nonpharmacological behavior guidance techniques. Their simplicity, affordability, and ease of implementation make them a promising alternative for routine pediatric dental practice, particularly in settings with limited access to advanced distraction technologies.

Despite the favorable outcome, this report has several limitations. As a single-case report, the findings cannot be generalized to all pediatric patients because behavioral responses vary according to age, temperament, previous dental experiences, and baseline anxiety levels. Furthermore, the effectiveness of arithmetic puzzles was evaluated based on clinical observations without standardized behavioral or anxiety assessment instruments. Future prospective studies involving larger samples and validated outcome measures are therefore recommended to further evaluate the effectiveness of arithmetic puzzles as an evidence-based active distraction technique in pediatric dentistry.

CONCLUSION

The consistent application of nonpharmacological behavior management through distraction using arithmetic puzzles improved the cooperation of 10-year-old pediatric patients during the dental treatment series. This approach builds patient trust in the operator, reduces anxiety during the procedure, and increases adherence to the visit schedule until the entire treatment procedure can be completed properly. This case shows that the selection of behavior management techniques that are adapted to the patient's age, cognitive development, characteristics, and interests, and supported by parental involvement, is an important factor in achieving the success of children's dental care.

Operators are advised to conduct behavioral assessments from the first visit to determine behavior management strategies appropriate to the patient's age, cognitive development, experience, and characteristics. The consistent application of a combination of basic communication, distraction, desensitization, and *positive reinforcement* techniques at each visit needs to be prioritized before considering pharmacological approaches. The use of distraction media that suits children's interests, such as educational games, can be an effective alternative to increase patient comfort and cooperation. In addition, parental involvement needs to be optimized as part of a *family-centered care* approach. Further research with a larger sample size, prospective design, and the use of standardized behavior assessment instruments, such as the Frankl Behavior Rating Scale, Venham Anxiety Scale, or Facial Image Scale, are needed to evaluate the effectiveness of each behavior management technique more objectively.

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