



Audio–visual storytelling for reducing dental anxiety in Iranian children: a randomized controlled trial

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Abstract

Purpose The aim of the study was to compare the effectiveness of the audio–visual storytelling method and the "tell–show–do" (TSD) technique on reducing children's dental anxiety.

Methods A controlled clinical trial study was performed with two experimental groups and a control group. Forty-five 6-to-9 years old children were randomly divided into the groups. Venham Picture Test and Facial Image scale were used as measurement tools. Repeated measures analysis of variance and Bonferroni post hoc test were used to evaluate the interventions.

Results The results of the post hoc test showed that there was a significant difference between the mean scores of the control group and storytelling group according to both anxiety scales ($p=0.001$). Also, there was a significant difference between the mean scores of the control group and TSD group according to both anxiety scales ($p=0.01$).

Conclusion The audio–visual storytelling appears an effective, applicable method for reducing children's dental anxiety. However, it is significant to select an appropriate story and also to consider the dentist–patient relationship.

Keywords Behavior management · Dental anxiety · Tell · Show · Do · Storytelling

Introduction

Dental anxiety disorders (fear, anxiety, and phobia) are prevalent problems in dentistry and frequently significant obstacles to oral health because of avoidance of dental treatment. Patients with dental anxiety disorders generally have reduced oral health. Poor oral health and awareness of a dental avoidance problem may give rise to embarrassment, reduced social functioning, and possibly reduced quality of life (Raadal and Skaret 2013). The estimate is that 6–15% of the world's adult population suffers from the avoidance of dental care due to high dental anxiety and phobia (Eli et al. 2004).

A systematic review study which has been done by Grisolia et al. (2021) showed that the overall pooled dental anxiety global prevalence has been estimated to be 23.9% in children

and adolescents. Pooled prevalence in preschoolers, school children, and adolescents has been reported 36.5%, 25.8%, and 13.3%, respectively (Grisolia et al. 2021).

Dental anxiety also seems to be frequent among Iranian children and adolescents. The prevalence of high and severe dental anxiety has been reported between 13.3 and 29.33% in children and/or adolescents (Paryab and Hosseinbor 2013; Nilchiyan and Mohammadi 2013; Ghasempoor et al. 2004; Hamissi et al. 2012).

Anxiety disorders are usually complex with a multifactorial etiology. However, three main reasons for the development of dental anxieties have been suggested: (i) direct conditioning, which originates in early, aversive encounters in the dental office (ii) vicarious learning, through role models, such as family, peers, and society, and (iii) psychodynamic and personality aspects, i.e., specific traits that when present, increase the patient's proneness for apprehension in the dental setting (Eli et al. 2004).

Conditioning is the most commonly utilized pathway of dental fear and anxiety used by the patients; whereby past painful dental experience may negatively impact an individuals' future dental attendance (Minja and Kahabuka 2019).

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In this regard, McElroy stated, “although the operative dentistry may be perfect, the appointment is a failure if the child departs in tears” (Wright and Kupietzky 2014a).

Several inquiries have revealed that the technique called “tell–show–do”(TSD) has remained the most commonly used technique in pediatric dentistry (Farhat-McHayleh et al. 2009). The TSD technique has been recommended to be used routinely by all members of the dental team who work with children (Stigers 2016). In this technique, attempts are made to remove the unknown which evokes fear and anxiety. This method could be used on a young child who lacks dental preconditioning at a first visit. It could be used for a child who is fearful because of a previous painful experience in another dental office, or for one who is apprehensive because of information received from parents or peers (Wright and Kupietzky 2014b).

However, the proper application of the TSD method may be time-consuming for dental professionals in crowded public dental clinics with staff shortages. The DMFT index (decayed, missing, and filled teeth) for 5–6-year-old children has been estimated to be 5.16 at the national level in a 2018 study in Iran and 85.93% of dmft results have been related to d-component (decayed teeth). Whereas only about 12.7% of the 5–6 year-old children have been estimated to be caries-free (Khoshnevisan et al. 2018). The public health centers provide lower-cost dental treatment services along with free preventive dental care services for children and adolescents. However, unfortunately, in urban areas, the number of dentists, dental hygienists and oral health technicians is insufficient to cover all the primary school children referring to health centers (Khoshnevisan et al. 2018). Therefore, there is usually a load of young patients in these public centers and dental professionals might not be capable of performing the TSD technique properly. We were looking for an anxiety management method for such situations. Media-based audio–visual storytelling appeared to be an applicable nonstaff-based method. It could be applied on the basis of cognitive–behavioral theory as a modeling technique. Modeling techniques have been evidenced to be efficient in reducing anxiety disorders and also dental anxiety in a number of studies (Farhat-McHayleh et al. 2009; Schultz and Schultz 2012; Alnamankany 2019). Likewise, storytelling has been reported to be efficient in reducing dental and medical anxiety in a number of studies (Kebriaei et al. 2022; Khokhar et al. 2017; Khoshnevisan et al. 2018). Also, positive previsit imagery, has been recommended (American Academy of Pediatric Dentistry (AAPD) 2015).

The aim was to compare the efficiency of the audio–visual storytelling method with the TSD technique in reducing dental anxiety in children.

Materials and methods

Participants

This is a prepost study which is carried out on children in Shiraz city, the center of Fars province that is located in south west of Iran. The study was done in the summer of 2020. One public health center in Shiraz was randomly selected by lottery. Participants were chosen from patients referring to the center in the summer of 2020. Children aged 6-to-9 years, whose parents/guardians agreed to take part, and needed pulpotomy of either fourth or fifth primary teeth (D or E), were included in the study. The exclusion criteria were the history of psychiatric treatment and/or receiving psychiatric medication.

Sample size

The sample size was 45. The study was a randomized controlled trial (RCT). The RCT studies are categorized among interventional studies which provide the high level of evidence in research. In this type of studies samples are allocated to studied groups randomly that lead to control the effect of potential confounding variables.

Individuals were divided into three groups, including a control group and two experimental groups (storytelling group and TSD group). In order to perform the TSD method, a dentist who was already familiar with this method was invited. 15 children were assigned to each group randomly.

The sample size was determined based on the minimum sample size recommended for clinical trials according to Gall et al. (2003):

“The general rule in quantitative research is to use the largest sample possible. The larger the sample, the more likely the research participants' scores on the measured variables will be representative of population scores. In addition to this general rule, researchers have developed rules of thumb for determining the minimum number of participants needed for different research methods. In correlational research, a minimum of 30 participants is desirable. In causal–comparative and *experimental research*, *there should be at least 15 participants in each group to be compared*. For survey research, Seymour Sudman suggested a minimum of 100 participants in each major subgroup and 20 to 50 in each minor subgroup.”

Confining to the sample size to the minimum number was due to the following reasons: (1) coronavirus

pandemic (which made us to be more precautious), (2) trying not to interfere a lot in routine procedures at the public health center according to the rules.

Sampling and randomization

Available random sampling method was performed. The children who referred to the center and were in the desired age range were invited to participate in the study by the dental secretary. The children were randomly assigned to one of the groups by lottery with no regard to the will of researchers or samples' condition and preference. In order to equalize sample number to each study groups, the block randomization method was used. The randomly allocation of samples to intervention groups and control group was concealment and have been done by principal investigator. Each participant took a card. The hidden number on the card specified the group. In case that a child was excluded from the study, the next child who referred to the center was invited, until 15 participants were included and their treatment was done.

Implementation of the study

This study carried out in two main phase. In the first phase, the measurements of anxiety have done in tow times of the arrival time to clinic and at the end of the dental examination. After the measuring the anxiety in arrival time, the considered interventions (storytelling or TSD) have been implemented on the samples.

The measurements in control group were the same of trial groups, but there were not any interventions to reduce the anxiety.

Ethical concerns

The necessary permissions and also, the ethical code (IR.SUMS.REC.1399.632) and the clinical trial number (IRCT20210501051145N1) was obtained.

The parent/guardian agreements for participating in the study was signed by them after understanding the study procedure. Children were also asked about their willingness to participate in the study. In cases where any of the children or their parents were not willing to participate in the study, they were excluded.

The audio–visual story used in the study would be unpublished until obtaining the necessary permissions from the publishing company.

All infection control procedures were performed according to the instructions of National Headquarters for Corona Disease Management.

The treatment costs were paid by Dastan-Mehr-Ali NGO. The study was performed with the consent of the dentists

participating in the study. (The name of dentists is not registered in any document.)

Study design

The control group underwent the routine clinical procedure at the health center without any *extra* interventions. Basic anxiety reduction methods like communication and reinforcement are usually performed during routine procedures. The anxiety scores in this group were considered as baseline reference for comparison with the other two groups.

In order to implement the storytelling method in the second group, the Persian translation of the story book *Going to the Dentist (Usborne First Experiences)*¹ was used. The *Going to the Dentist* book makes children enthusiastic about going to the dentist and prepares them for the appointment. The story is about two kids (*Jake and Jessie Judd*) visiting a dentist who checks their teeth and cleans them, fills in Jake's cavity, and tells them to take care of their teeth.

The audio–visual story was made via "windows movie maker" software. In some cases, pictures of dental instruments were added. Also, in some cases, phrases and similes were added to the main story of the book. For example, a dental chair was compared to a spaceship seat, the sound of dental equipment to a space sound, and the smell of dental materials to a space smell. In addition, during the recording of the story, the sound of a dental turbine was added to the story.

To perform the TSD method in the third group, a dentist who was already familiar with TSD and already was used to implementing the method in his clinical work was invited. The method was reviewed to the dentist and his assistant based on the introduction by Wright and Kupietzky (2014a, b) (Wright and Kupietzky 2014b).

Two other dentists who accompanied in the study for dental examination and dental treatment were randomly selected based on their presence at the center. In order to have the same performance of dentists, the necessary trainings were provided.

Neither of the two latter dentists was aware whether the children were in the storytelling group or the control group.

The study process was performed in two sessions. The clinical procedure in the first session included dental examination, and the procedure in the second session was pulpotomy of a molar primary tooth.

Children's anxiety was measured in five stages: first session: (1) upon arrival, (2) after dental examinations. Second session: (1) upon arrival, (2) on the dental chair (after injecting the anesthesia), (3) after the dental procedure.

¹ Civardi A. *Going to the Dentist (Usborne First Experiences)*. UK: Usborne publishing.

For the storytelling group, the story was broadcast to the children after the initial anxiety assessment and before the beginning of the dental process, in the waiting room, and for the TSD group, anxiety reduction intervention was performed during dental procedure.

In order to remove the parental effect on the results, all parents were excluded in the process of study after obtaining informed consent.

Measurement tools

"Venham Picture Test"(VPT) and "Facial Image Scale"(FIS) were used to measure children's anxiety.

VPT consists of eight cards. There are two figures on each card, one in which a child appears happy and the other one in which he looks distressed. Children were asked to point at the figure they felt most like at that moment. If a child chose the anxious figure, his/her anxiety level was documented 1 and if he/she chose the nonanxious figure, the anxiety score was documented 0. The sum anxiety scores were between zero and eight. FIS is a card that consists of five images of faces that are arranged from "very happy" to "very sad". The card was shown to children, and they were asked to choose the face which best expressed their feeling. A very happy image was given a score of one and a very sad image was given a score of five. In both scales higher scores indicated greater anxiety.

Data analysis

The data were analyzed using SPSS software (SPSS 24.0 for Windows, SPSS Inc., Chicago, USA). Repeated measures analysis of variance was used to evaluate the procedures. (Box's M, Mauchly's and Wilk's Lambda tests were provided. Geisser–Greenhouse test was also given along with the associated test power.) Bonferroni post hoc test was performed on each pair of the groups.

Results

Descriptive statistics

The mean age of children referred to the health service center in the control group, TSD group and storytelling group was 7.60, 7.80 and 7.46 years old, respectively. The observed difference between the age groups was not statistically significant ($p > 0.05$). The number of girls in the control group, TSD group and storytelling group were 8 (53.3%), 9 (60%) and 7 (46.7%) respectively. 53.3% of the children participating in the study were girls and 46.6% were boys. 60% of children had problems in their upper teeth and 40% in their lower teeth.

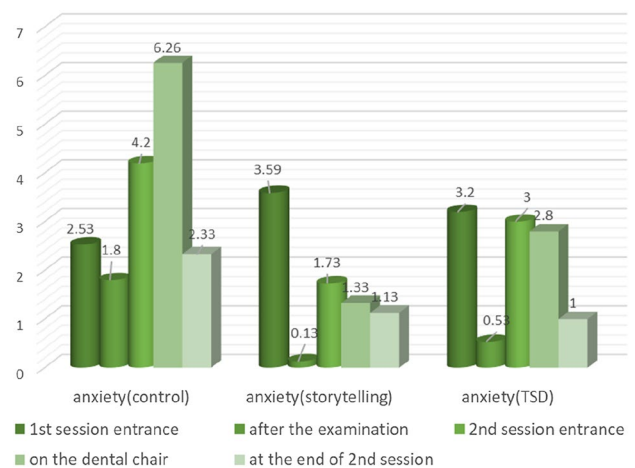


Fig. 1 The Mean Score of Children's anxiety in different stages of the study according to VPT

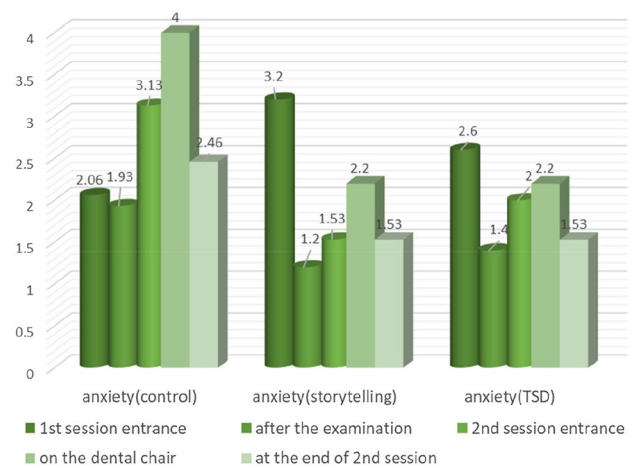


Fig. 2 The Mean Score of Children's anxiety in different stages of the study according to FIS

According to both scales (FIS and VPT), in both the TSD and storytelling groups, the mean scores of children's anxiety had decreased in all four stages (after examination, at the beginning of the second session, on the dental chair, and at the end of the second session) compared to the beginning stage (Figs. 1, 2).

Inferential statistics

The data analysis showed significant difference between the mean (FIS and VPT) scores of the experimental groups and the control group ($p = 0.001$). The results of the post hoc test showed that there was a significant difference between the mean scores of the control group and storytelling group according to both anxiety scales ($p = 0.001$). Also, there was a significant difference between the mean scores of

Table 1 The results of ANOVA and post hoc for comparison between groups

Variable	A	B	Mean difference	Standard error	<i>p</i> value
Venham Picture Test	Beginning of session 1	After examination	2.13	0.56	0.005
	After examination	Beginning of session 2	-1.88	0.44	0.001
		Medical chair	-2.51	0.42	0.000
	Medical chair	End session 2	1.97	0.43	0.000
	Control	Storytelling	1.06	0.26	0.001
		TSD	0.77	0.26	0.017
	Storytelling	TSD	-0.29	0.26	0.83
Facial Image Scale	Beginning session 1	After examination	1.06	0.31	0.01
	Beginning of session 1	After examination	1.06	0.31	0.01
		Beginning of session 2	-0.77	0.22	0.01
	Medical chair	Medical chair	-1.08	0.23	0.001
		End session 2	0.822	0.21	0.005
	Control	Storytelling	1.92	0.51	0.002
		TSD	1.32	0.51	0.04
Storytelling	TSD	-0.60	0.51	0.76	

the control group and TSD group according to both anxiety scales ($p=0.01$). No significant difference was observed between the mean scores of the storytelling group and TSD group (Table 1).

Discussion

In this study, VPT and FIS were used to measure dental anxiety. Many different assessment methods are available; however, the ideal measure should be valid, allow for limited cognitive and linguistic skills, and be easy to administer and score in a clinical context (Buchanan and Niven 2002). VPT is one of the few picture scales available that covers all these criteria (Morgan et al. 2017) and has been used in several studies to measure children's anxiety (Pakdaman and Davodi 2015; Khokhar et al. 2017; Olivera et al. 2018).

The above scale has some limitations e. g. Krishnappa et al. (2013) have stated that the “figures on the cards of VPT are all male, that might present problems when the young patient is a girl” (Buchanan and Niven 2002). In this study, we found that some emotions might look ambiguous for a number of children. It also seemed that a few children chose either all the anxious or nonanxious images depending on their dominant feeling.

Since the possible shortcomings of VPT were predicted, the FIS was also used in the study.

“It is easy for younger children to choose between images” (Buchanan and Niven 2002). and this scale also has been used in a number of studies (Khokhar et al. 2017; Olszewska and Rzymiski 2020; Pande et al. 2020).

In a 2018 study by Gawthaman et al. measuring the anxiety of 3–14 y/o children comparing visual and nonvisual

tests, there was a moderate difference between the level of anxiety measured by visual and nonvisual scales in 7–10 y/o children, and 60% of children found it easier to evaluate image scales (VPT and FIS) (Gawthaman 2018).

The reliability and validity of both of the above scales have been reported in foreign samples (Morgan et al. 2017; Nilchiyan and Mohammadi 2013), and the reliability and validity of VPT and the validity of FIS have been confirmed in Iranian samples (Javadinejad et al. 2011).

The present study's results demonstrated the TSD technique's effectiveness in reducing dental anxiety. According to Wright and Kupietzky (2014a, b), “Nothing evokes fear or anxiety more than the unknown. In the TSD technique, attempts are made to remove the unknown” (Wright and Kupietzky 2014b).

The audio–visual storytelling method in this study was based on the cognitive–behavioral theory and was used as a preappointment behavior modification method. The merit of this strategy is that it prepares the pediatric patient and eases the introduction to dentistry (Stigers 2016). Different methods of preappointment behavior modification are recognized. *Positive previsit imagery* and *modeling techniques* are among them which have established the strategy of this study.

Positive previsit imagery refers to the method which introduces patients to positive photographs or images of dentistry and dental treatment in the waiting area before the dental appointment. The objectives are to provide children and parents with visual information on what to expect during the dental visit and to provide children with a context to ask providers relevant questions before dental procedures are initiated (American Academy of Pediatric Dentistry (AAPD) 2015).

Films or videotapes have been developed to provide a model for the young patient. The goal is for the patient to reproduce the behavior exhibited by the model. The technique can also be performed with live patient models such as siblings, other children, or parents (Stigers 2016). Modeling techniques have been effectively used in cognitive-behavioral therapies for anxiety disorders. The rationale is that just as modeling techniques could lead to anxiety disorders, they could also help alleviate them (Schultz and Schultz 2012). However, Stigers (2016) states that: “most modeling studies indicate that there is merit in introducing children to dentistry in this way, but not all studies show statistically improved cooperative behavior on the part of the children. The lack of replication may result from differences in experimental design, dental teams, videotapes, or films. It suggests a necessity for careful videotape or film selection” (Stigers 2016).

In this study, the story was selected due to the following reasons:

1. It had been identified as suitable for the target group of this study and had been approved and introduced by Iran's Ministry of Education.
2. The characters in this story were human (both girls and boys), which could help children identify with the characters and provide a model for them.
3. The images of the story's main characters were almost similar to Iranian children, which could promote children to identify with the characters.

Children like stories. Storytelling could create a favorable atmosphere in the clinical environment. Children can identify with the stories' characters and accompany them in their fictional experiences. Storytelling has been reported to be efficient in reducing dental and medical anxiety in a number of studies (Sekhavatpour et al. 2019; Aminabadi et al. 2012; Pakdaman and Davodi 2015).

Aminabadi et al. (2012) evaluated the effect of listening to a pictorial story about going to the dentist on pain perception, situational anxiety and behavioral feedback during dental treatment in pediatric dental patients. Eighty, 6–7-year-old children were randomly assigned to two groups, listening to a pictorial story about going to a dentist (test) or listening to a pictorial story about going to a barbershop (control). Dental treatment was performed on each subject, during which behavior, pain perception and situational anxiety were assessed. The results showed that there was a significant decrease in pain perception ($p=0.02$) and situational anxiety ($p<0.001$) in the test group. In addition, the test intervention significantly improved children's behavioral feedback during dental treatment ($p<0.001$) (Aminabadi et al. 2012).

Pakdaman and Davodi (2015) evaluated the effect of story therapy on dental anxiety, pain and anger in 4-to-8 year-olds. Measurement instruments included the VPT, the Wong–Baker Faces Pain Scale and the Children's Anger Scale. Children were randomly divided into three groups:

experimental, placebo and control. The experimental group received eight sessions of group intervention. The control groups did not receive any interventions, and the placebo group received eight sessions of folk tales. The results showed that the experimental group's mean scores of anxiety, pain and anger were significantly reduced compared to the placebo and control groups (Pakdaman and Davodi 2015).

The results of the mentioned studies are consistent with the results of this study as they demonstrate the effectiveness of storytelling in anxiety reduction.

Elicherla et al. (2019) evaluated the comparative effectiveness of a mobile app (Little Lovely Dentist) and the TSD technique in managing dental anxiety and fear. Fifty 7–11 years old children were randomly allocated into the dental app group or the TSD group. The pre- and postoperative anxiety of children who underwent prophylactic cleaning was assessed physiologically and subjectively. They concluded that educating the child before a dental procedure using the mentioned smartphone application can significantly alleviate anticipatory anxiety. That is consistent with the use of the audio-visual storytelling method in this study (Elicherla et al. 2019).

Audio-visual stories could be interesting for children. Also, they can help the dental team in saving time. However, the patient–dentist relationship remains a concern. Many research efforts have been dedicated to finding optimal principles for building a successful relationship between patients and physicians. The presence of a personal doctor, the congruence between patient preferences and practitioner style, the patient-centered practice of the physician, the quality of the doctor–patient communication, and the existence of a mutual agreement concerning the health problem and its treatment were shown to be among the key drivers of improved patient satisfaction with service providers and overall care (Tofan et al. 2013). The audio-visual storytelling method in this study was used as an anxiety reduction tool but not a patient–doctor model. It is used as a preappointment method for introducing the procedure and as previsit imagery to provide children with context which makes them able to ask questions. Therefore, it seems consistent with a patient-centered relationship and could help the mutual agreement concerning the health problem and its treatment be formed. However, it should be pointed out that the anxiety of children in dental clinics can be affected by other factors. In a study, Wu and Gao (2018) showed that family structure (nuclear or single-parent family) and the presence of siblings are significant factors for children's dental anxiety. Moreover, parental anxiety (AlQhtani and Pani 2019), past dental/medical experiences (Kebriaei et al. 2022), and psychological factors (Kroniņa et al. 2017) are related to children's anxiety. (Wu and Gao 2018). Also, Dahlander et al. (2019) investigated the factors associated

with dental fear and anxiety among children. They found that the children's anxiety and fear are related to the experience of dental care and parental dental fear (Dahlander et al. 2019). These factors were not considered in this study.

Morgan et al. (2017) investigated children's experience of dental anxiety. They interviewed dentally anxious children aged 11–16 years. Participants in their study identified empathic dental professionals as positively influencing dental anxiety. Conversely, criticism by a dental professional promoted dental anxiety in children. Children also valued communication and information-sharing considerably (Morgan et al. 2017). The storytelling model does not seem to contradict the dentists' empathic and welcoming behavior that is needed to reduce children's dental anxiety and also provides information for children.

Limitations and further suggestions

There have been limitations in this study and also there are suggestions for future studies.

A limitation that might have affected the results of the current study is the sample size. The previously mentioned size was determined based on the minimum sample size recommended for clinical trials (Gall et al. 2003) since further interference in the procedures of the health centers was not possible. Also, other anxiety determinants such as parental behavior, socioeconomic status, previous dental visits might have affected the results of the study. Another limitation in our study might be related to anesthetic injection methods. The difference between the injection methods for mandibular vs. maxillary operations may cause different anxiety levels. This might have led to bias in the results. Also, however, the dental clinic was selected randomly, there might have been some potential selection bias.

In future studies, objective anxiety measurement tools, such as galvanic skin tests or heart rate measurements could be added to the study design. The VPT could be considered for application. However, the images can be designed for both girls and boys. Also, it is suggested for future studies to investigate children's anxiety by asking their opinions using qualitative studies.

The strength of the study might be the investigation of audio–visual storytelling and the impact of the method on reducing dental anxiety using the RCT study.

Conclusion

It seems that dental professionals in crowded dental clinics could consider the benefits of audio–visual preappointment story-telling as a modelling technique for young children to manage dental anxiety, and the book "Going to a Dentist" could be considered for use as a preappointment story for

6-to-9-year-old children. Dentists may consider audio–visual storytelling as a method of communicating with children and reducing their anxiety during examination and treatment.

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Declarations

Conflict of interest The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or nonfinancial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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