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# Multifaceted distraction technique: an innovative tailored approach in dental settings for anxiety reduction in children: A preliminary report

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## Highlights

- The new multifaceted distraction technique based on the new "Van–Pan–Nik" concept to vanish panic attacks reduces procedural anxiety in children visiting dental clinics.
- The technique combines stress relaxation techniques with coordinated visual distraction.
- This preliminary report confirms that the multifaceted distraction technique is easy to use, clinically acceptable, safe, and effective for behaviour management in anxious children.

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## Abstract

**Aim:** This study aimed to evaluate the useability of a new multifaceted distraction technique and its effects on dental anxiety reduction in children. **Methods:** This in vivo experimental study included 54 anxious children with an Modified Child Dental Anxiety Scale- Face Version score>19. Multifaceted distraction was used to relax and distract the children during dental treatment. Ease of use, attractiveness, functionality, and changes in anxiety scores before and after treatment were assessed in the paediatric patients. The scores obtained were tabulated and statistically analysed using the Wilcoxon signed-rank and paired t-tests. **Results:** The multifaceted distraction technique was attractive, easy to use, and reduced procedural anxiety in 98.15% children aged 3–10 years. **Conclusions:** Within the limitations of this study, the multifaceted distraction technique was an effective behaviour management technique for reducing procedural anxiety in young children.

**Keywords:** Behaviour Management; Child Behaviour; Dental Anxiety; Paediatric Dentistry; Stress Relaxation

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## INTRODUCTION

An unfamiliar environment with anxiety-provoking stimuli, such as the sight of a syringe or the sounds of an air rotor, may elicit nonspecific feelings such as apprehension, worry, discomfort, or fear in children.[1] This may affect the quality of the treatment outcome and the child's attitude toward the dental profession. The acceptance of dental treatment procedures depends solely on the child's experience at the first or previous dental visit. Gaining the child's trust and cooperation is paramount for treatment success.[2] Children can potentially be confused with the dentist's frame of reference, and few can express their fears because of poor communication skills.

Distraction therapy is commonly used in Paediatric dentistry to help children cope with painful and difficult procedures. It aims to divert children's attention from pain or anxiety-provoking situations by allowing them to focus on something else. Distraction can be either active, in which the child is engaged with multisensory components, or passive, in which distraction is achieved by observing a stimulus rather than by active participation.[3] The most successful passive distraction techniques are audiovisual goggles, which are portable, lightweight head-mounted displays and headphones connected to devices that engage the child's visual and auditory senses and partially isolate the child from the dental treatment room.[4]

Virtual reality (VR), taste distraction, magic tricks, sensory stimulation, or working memory are emerging techniques in paediatric dentistry.[5-9] Playful distraction such as video games on cell phones are often used to actively engage the child during the procedure; however, their use may obstruct the operator's vision.[10] Moreover, dependence on gadgets may cause VR sickness in children.[5,10]

Since play interests and preferences in children vary depending on their cognitive levels, it is important to provide a creative approach that is suitable for children of different age groups and that distracts them during dental procedures without causing side effects. By directing the child's attention to something attractive and appealing, the child's ability to cope with painful stimuli is enhanced without causing personal harm. Considering these, a new multifaceted distraction technique which actively engages the child to avoid procedural interruptions was designed based on the unique "Van–Pan–Nik" concept, named after the researchers. This gaming concept was designed based on different interventional studies that mainly included sensory stimulation by squeezing an inflation bulb for relaxation and coordinated visual distraction as an alternative to audio visual aids/ video gaming.[4, 8,10-12]

This new distraction technique uses an integrated system mounted on the dental chair. The system consists of an inflation bulb attached to the handle of the dental chair, which can be easily grasped by children. The inflation bulb is connected to an elongated hollow tube extended to the patient's eye level with a balloon is attached its end. During a fear- inducing dental procedure, children are instructed to slowly inflate the balloon using one or two hands depending on their comfort level. This sensory stimulation aids relaxation.[8,11,12] When the bulb is squeezed, the pressure created inflates the balloon, causing visual distraction.[4,10] Thus, this technique actively engages the child and distracts them from distressing situations without potentially harming them or disturbing the operator.

The implementation of this distraction technique may encounter challenges such as parental attitudes, child acceptance, and tolerance.

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Hence, the present formative study aimed to assess the useability and clinical effectiveness of the new multifaceted distraction game in clinical dental settings for reducing procedural anxiety in paediatric patients.

The primary objective of this study was to evaluate procedural anxiety by 1) comparing pre- and post-anxiety scores and 2) observing the child's behaviour during the procedure. In addition, useability testing was performed to assess the attractiveness, useability, and functionality of the game from children's perspective by observing them during treatment and through personal interviews.

## METHODS

### Study design

This study was conducted in the outpatient department (OPD) of Pedodontics and Preventive Dentistry of a regional dental college and hospital. According to Piaget's[13] theory of cognitive development, children of different age groups are at different stages of psychosocial development and are likely to respond differently to dental procedures and therapeutic play.

Children and accompanying parents/guardians waiting in the OPD were invited to participate in the study. Written informed consent was obtained from all participants before commencement of the study. Ethical approval was obtained from Institutional Ethical Committee, GITAM Dental College and Hospital, (dated April 03, 2023, protocol number: 23086031823) in accordance with the Code of Ethics (Declaration of Helsinki).

### Sample size estimation

Based on the results of anxiety scores from previous intervention studies,[6,8-10] the minimum sample size required for a detectable minimum effect of at least 0.6 with a power of 80% at a significance level of 5%, was 42. Considering a failure rate of 20%, 54 children were recruited for the study.

### Inclusion and exclusion criteria

Healthy children aged 3–10 years who visited a dentist for the first time were included in this study. Dental anxiety and fear were measured using the Modified Children Dental Anxiety Scale - Face Version (MCDASf). The MCDASf consists of eight questions with faces/emoticons rated on a five-point Likert scale (1–5). The total MCDASf score ranges from 8 to 40. Children with a score ≥19, indicating dental anxiety, were selected for the intervention according to Howard et al.[14]

Children with psychological, medical, or developmental problems listed in their medical records were excluded. The accompanying parent/guardian of each child was invited to assess their satisfaction with the procedure.

### Participant selection

A total of 73 children were examined in the OPD, of which 54 eligible children with a mean age of 7.26 ± 1.48 years (median, 7.00; range, 3–10 years) were included in this study. Five children did not meet the inclusion criteria, and 14 declined to participate in the study due to lack of time or interest. A flowchart of the study design in accordance with the Consolidated Standards of Reporting Trials is shown in Figure 1.

### Clinical procedure

No specific dental procedures or treatments were selected to increase the generalisability and potential applicability of the results in clinical practice.

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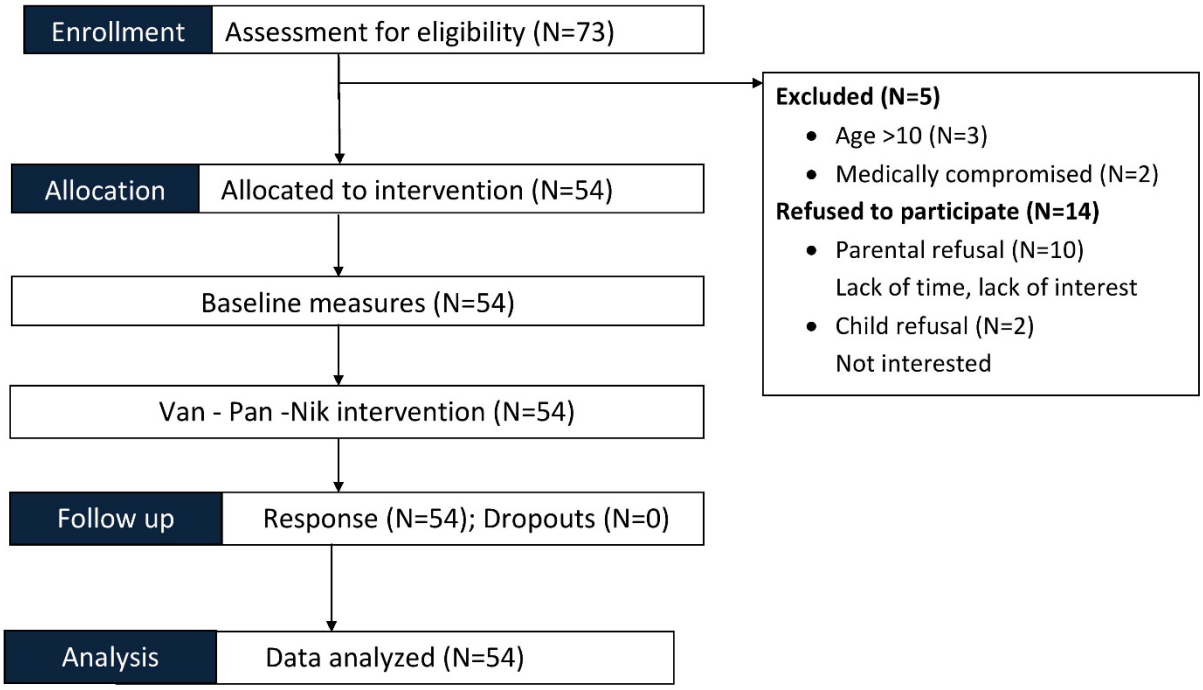


Figure 1. Flowchart of the study

Participants underwent various dental procedures, including oral prophylaxis (N=11), cavity preparation using a high-speed air rotor handpiece (N=12), pulp therapy under local anaesthesia (N=14), and extraction under local anaesthesia (N=17). At baseline, each child was treated in a sitting position and educated about the procedure using the tell-show-do technique. The Raghavendra, Madhuri, Sujata Pictorial Scale (RMS-PS)[15] was used to assess preoperative anxiety in children (subjective response). The scale consists of a series of five faces ranging from very happy to very unhappy; two separate sets of photographs were used for boys and girls. The children were asked to choose the face that closely matched their feelings.

## Intervention

Participants were informed about the use of the multifaceted distraction device (Figure 2A), which was integrated with the dental chair, using the tell-show-do technique. Children were asked to slowly inflate the balloon, which was at eye level during treatment, using one or two hands, depending on comfort (Figure 2B). The researcher also explained the procedure to the accompanying parents, and the treatment was performed along with distraction. Anxious and disruptive behaviour was assessed using the Anxious and Disruptive Behaviour Coding, as described by Mhaske.[16] Code 'B' was provided for a single movement or a continuum of uninterrupted movements ≥15 cm of any body part. Further, codes 'C', 'CO', and 'V' were assigned for crying, complaining, and vocalisation in general (apart from responses to questions, laughter, or speech that were obviously not due to pain), respectively. Code 'R' was assigned when the dental assistant/parent tried to keep the patient under control. Light touching to calm the child or hands placed on the child to prepare them for a possible disturbance were not counted. Code 'D' was assigned when the disruption interfered with the dental treatment and caused the dentist to stop temporarily. Post operative anxiety was assessed using RMS-PS.

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Figure 2. A: Multifaceted distraction system; B: Local anaesthesia administration using the multifaceted distraction technique

**Secondary tasks**

In few children, technical modifications were made to extend dental procedures beyond the allotted time. These included a) Opening of the air valve to release the pressure and encourage the child to repeat the procedure and b) Giving an additional task by incorporating a material reinforcer into the balloon and encouraging the child to concentrate and identify the object in the balloon while inflating it.

To determine useability, children were observed to see if they could play the game independently, and any technical difficulties were noted. In addition, the researcher observed how the children played the game, whether they became stuck or confused, and whether they could progress through the game without assistance. Attractiveness was assessed by observing participants' engagement and signs of enjoyment (frowning, smiling, and laughter) and interest (concentration). Functionality was assessed by observing whether the game served its purpose without interfering with dental treatment. After playing the game, participants were interviewed and asked to complete a self- administered closed-ended questionnaire to assess the acceptability, tolerability, and feasibility of the intervention.[17]

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Clinical observations including useability assessment and Anxious and Disruptive Behaviour Coding, pre- and post-operative RMS-PS scores, and post-intervention interview data were tabulated and statistically analysed using SPSS software version 22.0. Paired differences in the repeated measures of anxious and disruptive behaviour codes in the sample population were evaluated using the Wilcoxon signed-rank test. The RMS-PS scores at different time points were compared using a paired t-test.

## RESULTS

Most recruited patients (54/73) were included in the study. Fourteen participants [either the child (N = 4) or a parent (N = 10) refused to participate due to disinterest or lack of time.

### Results of useability tests

All children (N=54) who participated in the study showed interest in performing the task. No child discontinued or refused to continue. All children learned the task very quickly; however, few children initially had difficulty holding the inflation bulb (N=6) and pushing it slowly (N=5). Finally, 52 of the 54 children appeared confident and relaxed during the ongoing task. Nearly 53 children appeared engaged and seemed to enjoy the task. Anxiety reduction was observed in 98.15% of the children. In one child who was extremely anxious before dental treatment, this versatile distraction technique failed (Figure 3).

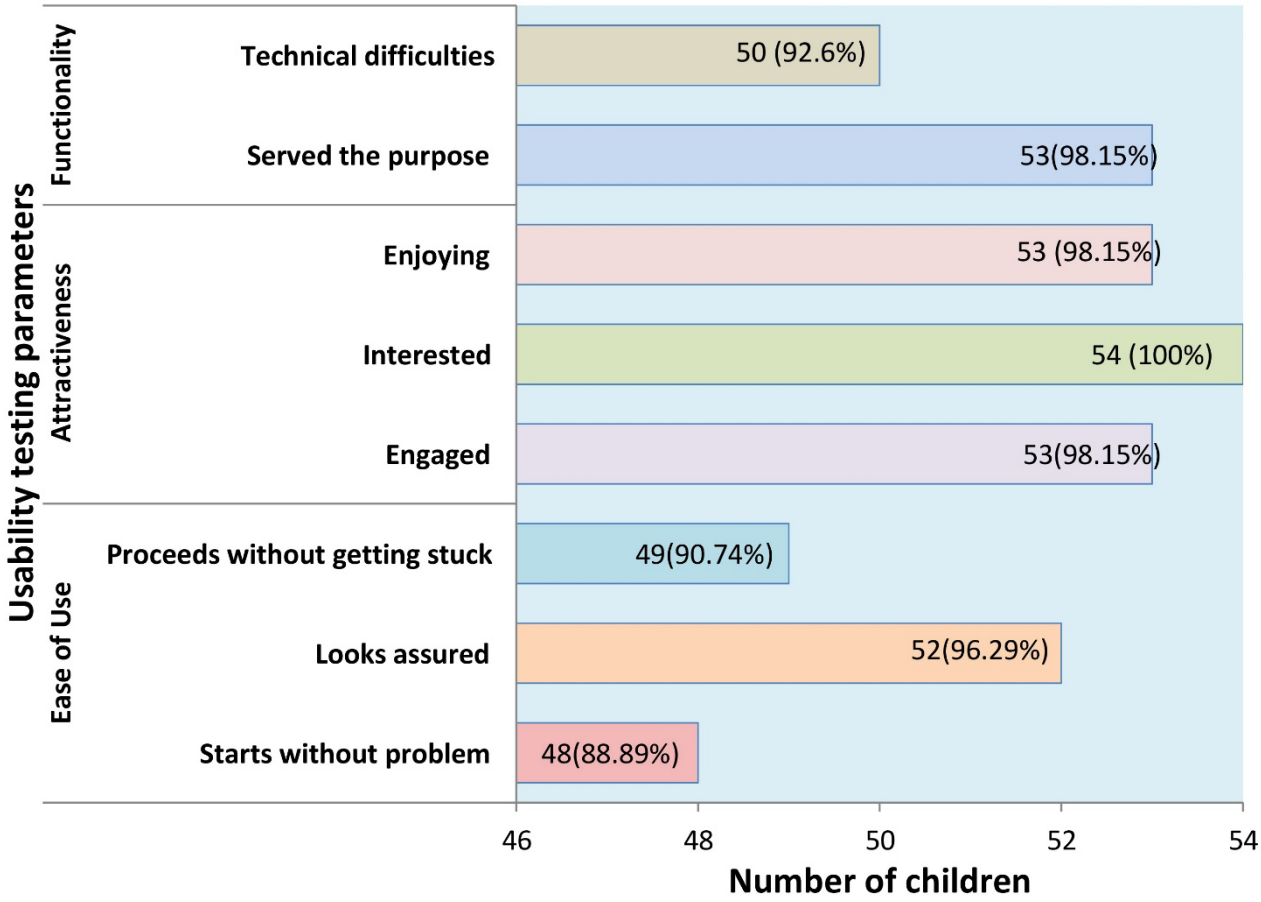


Figure 3. Graphical representation of clinicians' observations regarding children's perspective while using the multifaceted distraction technique

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### Preliminary clinical efficacy

According to the coding of anxious and disruptive behaviour, the total number of events such as body movements, crying, whining, vocalisation, and treatment disruption before multifaceted distraction was 189 (Table 1); body movements (N=43), whining (N=41), and restraint by parents to control the child (N=38) were the most common. The total number of events in the same patients during multifaceted distraction was 39 (Table 1). The total number of events was significantly different in the same patients before and during intervention ($P < 0.001$).

The RMS-PS score after application of the multifaceted distraction technique was significantly lower than the preoperative RMS-PS score (Mean ± standard deviation, 1.63±0.62 vs 4.13±0.67; $p < 0.001$), indicating a significant decrease in reported anxiety after the application of the Van–Pan–Nik concept of distraction (Table 2).

### During the interviews

No participant had been previously exposed to such a play task. Most children (70.37%) rated the game as excellent, and 27.78% described it as good. Overall, 50 children found the game easy to play, and 49 remembered detailed information about the task, its purpose, and how it helped them, while the rest could explaining the task well. Most children were enthusiastic about playing the game on subsequent visits and considered the visit to the dentist playful. Among all participants, 96.29% were interested in revisiting the dentist (Table 3).

## DISCUSSION

Behavioural problems in children generally occur when they are unable to cope with anxiety-provoking situations. McCaul and Mallot[18] reported that pain perception can be reduced if the child is distracted from the unpleasant stimulus. Behaviour management techniques aim to improve children's coping skills, achieve their acceptance of dental treatment through compliance, and ultimately change their perception of the dental environment.

Table 1. Anxious and disruptive behaviour scores before and during multifaceted distraction

| Sample size N=54 | Body Movements (B) | Crying ® | Complaining (CO) | Vocalization (V) | Restraint (R) | Procedural Disturbance (D) | Total no events |
|---|---|---|---|---|---|---|---|
| Before treatment | 43 | 18 | 41 | 26 | 38 | 23 | 189 |
| During treatment | 11 | 3 | 9 | 13 | 2 | 1 | 39 |
| | 0.00001* | 0.0013 | <0.00001* | 0.0014* | <0.000 | <0.00001* | |

*Wilcoxon sign ranked test, * indicates significant difference

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Table 2. Mean pre- and post-operative anxiety scores in children subjected to multifaceted distraction

| Intervention | PRE score (Mean ± SD) | POST score (Mean ± SD) | Mean difference (Mean ± SD) | Paired t-test statistic | P Value |
|---|---|---|---|---|---|
| Multifaceted distraction technique | 4.13± 0.67 | 1.63 ± 0.62 | 2.5±0.86 | t =21.2802 | <0.0001* |

Paired t- test; *indicates significant difference; SD: standard deviation

Table 3. Interview responses regarding useability of multifaceted distraction

| SI No | Interview framework for useability testing | Grading and Response Rate n (%) | | | | |
|---|---|---|---|---|---|---|
| 1 | What did you think about the game | Excellent | Good | Ok | Bad | Worse |
| | | 38 (70.4) | 15 (27.8) | 1 (1.8) | - | - |
| 2 | Have you played this type of game before? | Yes | No | | | |
| | | - | 54 (100) | | | |
| 3 | Do you find the game easy or difficult? | Easy | Difficult | | | |
| | | 50 (92.6) | 4 (7.4) | | | |
| 4 | Can you show me how to do it? | Good | Fair | Poor | | |
| | | 49 (90.7) | 5 (9.3) | 0 | | |
| 5 | Would you like to play the game all over again/continue playing? | Yes | No | | | |
| | | 53 (98.1) | 1 (1.9) | | | |
| 6 | Would you like to come to a dentist again? | Yes | No | | | |
| | | 52 (96.2) | 2 (3.8) | | | |
| 7 | What would you tell other children will happen if they have to visit a dentist? | Playful | Painful | | | |
| | | 53 (98.1) | 1 (1.9) | | | |

Cognitive behavioural therapies, such as relaxation exercises, positive self-talk, and deep breathing exercises, successfully reduce stress and pain during surgery in children.[19] However, children must be adequately trained in these techniques before surgery. In a previous study, a combined educational approach using video modelling successfully reduced children's anxiety but was limited by the poorly accessibility and inadequate staff.[20]

Distraction from procedures using play therapy is beneficial in healthcare settings.[21] Playful activities in childhood promote the development of motor and language skills.[22] Play can provide a positive distraction from painful or anxiety-provoking procedures or interventions.[23] Jones et al.[24] and Yogman et al.[25] reported that play can help children cope with stress, overcome fears, and develop stable self- esteem. It is important that all children, including verbal, nonverbal, or specially abled children struggling with any limitation, have the opportunity to play to cope with the challenges of the hospital environment and treatment procedures. Through play, children develop executive functions by redirecting their attention.

Early symptoms of VR sickness due to audiovisual aids include mild nausea, headaches, and eyestrain, which often progress to visual-

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motor dysfunction or postural instability with long-term dependence. However, validated measures for assessing VR sickness in children are lacking.[26,27]

A stress ball or soft rubber ball squeezed to reduce pain reduces attention to pain by competing with the sensory pain stimuli. Squeezing the ball is fun for children and an inexpensive form of active distraction in paediatrics.[11,28] Although this method has been used in paediatric patients, its effectiveness in reducing pain and dental anxiety has not been evaluated. However, in recent studies, the use of a stress ball alone did not alleviate anxiety in children during oral prophylaxis and administration of local anaesthesia.[8,29]

The present multifaceted distraction technique is based on the novel "Van–Pan–Nik" concept. This technique involves a visual task that interrupts the social and affective consequences of maintaining eye contact during dental procedures. Disruption is the affective, involuntary siphoning of the general processing of procedural anxiety.

Educating the child about the upcoming procedure and how the distraction technique will help them cope with the situation can help reduce uncertainty, separate imagination from reality, build confidence, and increase the belief that they can cope with stressful situations.[20] The Tell-Show-Do technique was used to educate participants about the upcoming multifaceted distraction procedure before it was performed.

This mixed-methods study examined the applicability and preliminary efficacy of the Van–Pan–Nik concept as a relaxation and distraction tool for paediatric patients in clinical settings. Young children lack abstract and logical thinking skills and translate their experiences into verbal statements. Furthermore, they may have difficulty expressing their feelings using words. Therefore, more than one assessment method was used to test the advantages and disadvantages of this distraction technique. Instead of the emotional responses of the children themselves, additional observations of a range of behaviours during dental treatment using codes for anxious and disruptive behaviours proved to be more useful in understanding their anxiety.

At the molecular level, children performing similar play activities had high levels of norepinephrine and low levels of cortisol, which may have indirectly affected brain function by buffering adversity and reducing toxic stress, consistent with coping and resilience.[25]

Indeed, distracting the child while squeezing the inflatable bulb with additional visual distraction may boost confidence and increase endorphin production. Serotonin 1A (5-HT1A) receptors are critical for mood and behaviour regulation. Previous research has shown that receptor levels decrease during maturation and that postnatal silencing of 5-HT1A autoreceptors increases anxiety levels.[30]

The attractiveness of the game was confirmed by the participants' long attention span and alleviated dental anxiety when balloons were blown up. Participants were engaged and attentive, squeezing the inflation bulb at a slow pace, especially while undergoing dental procedures. The time for which participants were engaged was extended by incorporating a secondary task with material reinforcers. However, this additional task had relatively little effect on anxiety reduction. Challenges encountered during this study: Difficulty in grasping and squeezing the bulb by young children and the absence of a pressure-regulating system to control the pace of balloon inflation could be considered shortcomings of this technique.

Useability testing and interviews with the children were conducted in a safe and comfortable environment. A trusting relationship was

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established, which was reflected in the children's enthusiasm and willingness to share their thoughts and opinions with the researchers. The responses and observations indicate a successful reduction in dental anxiety, and this technique is strongly recommended. This study provided ideas for further improving distraction games by modifying the design or incorporating secondary tasks, which led to adjustments before the concept was published.

The lack of useability test validation, small sample size, and lack of time estimation were considered limitations of this study.

## CONCLUSIONS

Within the limitations of this study, the results obtained from the children's responses and the clinicians' observations suggest that the new multifaceted distraction technique can potentially reduce procedural anxiety in dental clinics. This technique was widely accepted by a variety of paediatric patients aged 3–10 years with a high success rate. Further evidence-based comparative clinical studies with larger sample sizes are warranted to assess the feasibility of routine implementation of this versatile 'Van–Pan–Nik' multifaceted distraction technique in clinical dental settings.

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## Declarations

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