

## **Comparative Evaluation of Effectiveness of Three Distraction Techniques in Children Undergoing Pulpectomy**

### **Procedure**

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**Citation of this Article:** Dr Ramya V S, Dr Nandan N, Dr. Sunil Raj N, Dr Anitha Anand, Dr Soundarya Vishwanathan, “Comparative Evaluation of Effectiveness of Three Distraction Techniques in Children Undergoing Pulpectomy Procedure”, IJDSIR- March – 2026, Volume – 9, Issue – 2, P. No. 65 – 70.

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**Type of Publication:** Original Research Article

**Conflicts of Interest:** Nil

### **Abstract**

**Introduction:** Dental anxiety is common among children and adolescents, often causing behavioural challenges during treatment. Non-pharmacological distraction methods, both passive and active, are widely used to manage anxiety. While virtual reality and audio distraction have been studied, the effectiveness of POP-IT toys in dental anxiety management remains unassessed.

**Methodology:** The study involved 80 children aged 6–8 years, divided into four groups: Group A (Virtual

reality), Group B (Audio distraction), Group C (POP-IT toys), and Group D (control). All children were introduced to the procedure using the Tell-Show-Do technique. Anxiety levels were assessed before and after the procedure using the Facial Image Scale (FIS), along with pulse rate and oxygen saturation. Data were analyzed using paired t-tests and ANOVA.

**Results:** All the three study groups showed a significant difference in their spo2, pulse rate and FIS scores before and after the use of the distraction techniques. The Virtual Reality Group showed statistically significant

higher improvements, followed by the POP-IT Group and the Audio Distractor Group respectively.

**Conclusion:** The use of distraction techniques significantly reduces anxiety in children. Virtual reality and POP-IT toys can be used as a regular distraction tool in Pediatric dental practice.

**Keywords:** 3D Virtual Reality; Distraction Aids; Anxiety; FIS; Audio Distraction; POP-IT; Pulpectomy; pain perception; Play therapy.

### **Introduction**

Dental anxiety is a significant barrier to oral healthcare in children, affecting their ability to cooperate during treatment. It is one of the most common emotional responses in children and varies with age. Anxiety can lead to behavioural issues, making dental treatment stressful for both the patient and the practitioner. The prevalence of dental fear and anxiety (DFA) in children ranges from 5% to 20% across various countries, with severe cases classified as dental phobia<sup>1</sup>. Effective behaviour management is crucial for successful treatment.

Distraction is a widely used non-pharmacological strategy that diverts attention from unpleasant stimuli. Techniques like Tell-Show-Do, modelling, audiovisual aids etc have been widely used. Audio visual aids helps in controlling visual and auditory stimuli, often implemented through televisions or music<sup>2,3</sup>. Recent advancements include virtual reality (VR), which provides a highly immersive environment by blocking external stimuli and enhancing patient engagement<sup>4</sup>. Music therapy has also shown to reduce anxiety in various medical contexts and is more effective when personalized<sup>5</sup>.

Play therapy helps children express emotions and develop coping skills. It includes various approaches, such as sensory and motor-based activities, and aims to

reduce anxiety, improve self-control, and enhance problem-solving abilities<sup>6</sup>. POP-IT is a reusable silicone sensory toy with “bubbles” that can be pressed in and out, producing a tactile and auditory sensation. It engages children through repetitive motion and sound, providing sensory stimulation. While the effectiveness of VR and Audio distraction in reducing dental anxiety has been studied, there is little research on sensory tools like POP-IT toys. This study aims to evaluate the effects of VR, Audio distraction, and POP-IT toys on dental anxiety, pulse rate, and oxygen saturation in children.

### **Materials and Methods**

The study was conducted in the Department of Pediatric and Preventive Dentistry, Bangalore Institute of Dental Sciences and Hospital, Bangalore after obtaining approval from the Institutional ethical committee. The sample consisted of 80 healthy children, aged between 6-8 years full filling the selection criteria.

#### **Inclusion criteria**

- Children in good physical and mental health.
- Children with no history of allergies
- Children classified as Frankl Behavior Rating 2 or 3.
- Children requiring pulpectomy under local anesthesia and with no prior exposure to it.
- Informed parental consent.

#### **Exclusion criteria**

- Children with systemic illness
- Children with cognitive, hearing or visual impairments.
- Study participants were randomly divided into 4 groups consisting of 20 each
- Group A - 3D virtual reality glasses with audio [ANTVR 3D Glasses]
- Group B - Audio distractor [Boat rockerz wireless]
- Group C - POP-IT

- Group D - Control group



Figure 1: Distraction aids (a) 3D Virtual reality glasses with audio, (b) POP-IT, (c) Audio Distractor

Children included were oriented with the procedure they needed to undergo using the Tell-Show-Do technique. Children in all three study groups undergoing the

**Results**

Table 1: Comparison of mean difference in Pulse Rate & SpO2 levels between 4 groups from Baseline to After Treatment using Kruskal Wallis Test

Groups	N	PR (in bpm)		SpO2 (in bpm)	
		Mean	SD	Mean	SD
Group A	20	9.20	8.39	4.19	1.25
Group B	20	4.76	9.68	2.10	2.05
Group C	20	5.22	5.85	2.99	1.84
Group D	20	1.40	9.92	0.30	2.08
p-value		<0.001*		<0.001*	

Table 1 shows a statistical significant difference with respect to both pulse rate and SpO2 levels between the groups.

Group A (V R) showed a highest reduction in pulse rate  $9.20 \pm 8.39$  bpm and greater increase in spo2  $(4.19 \pm$

pulpectomy procedure were provided with the respective distraction aid (Fig1) for 5 minutes, after which the procedure was carried out. The distraction aid was given throughout the procedure. Anxiety was assessed before and after the procedure using the Facial Image Scale. Pulse rate and oxygen saturation levels were also assessed before and after the pulpectomy procedure using the pulse oximeter. The procedure was carried out using standard isolation techniques.

The obtained data was compiled, tabulated and statistically analyzed using Kruskal Wallis Test and One way Anova test.

1.25). This was followed by Group C where pulse rate decreased by  $(5.22 \pm 5.85)$  and spo2 increased by  $(2.99 \pm 1.84)$ . The control group D showed the least difference before and after treatment in both the physiological parameters.

Table 2: Comparison of mean difference in FIS Scores between Before & after Treatment period using Wilcoxon Signed Rank Test

Groups	Time	N	Mean	SD	Mean Diff	p-value
Group A	Before Rx	20	2.70	0.47	1.45	<0.001*
	After Rx	20	1.25	0.44		
Group B	Before Rx	20	2.60	0.50	0.45	

	After Rx	20	2.15	0.37		
Group C	Before Rx	20	2.50	0.51	0.80	
	After Rx	20	1.70	0.66		
Group D	Before Rx	20	2.85	0.59	0.25	
	After Rx	20	2.60	0.50		

Table 2 depicts comparison of mean FIS score before and after treatment with Group A showing highest difference of (1.45) followed by Group C (0.80).

A statistical significant difference was seen in all the experimental groups before and after treatment.

### Discussion

Dental anxiety in children and adolescents, significantly impacts oral health outcomes and treatment experiences<sup>7</sup>.

Dental anxiety refers to a deep-rooted feeling of fear or threat that can cause individuals to avoid dental visits. In Pediatric dentistry, the administration of local anesthesia is a common trigger for anxiety, with anxious children perceiving higher pain intensity and exhibiting uncooperative behaviour<sup>8</sup>. As a result, behaviour guidance techniques, both pharmacological and non-pharmacological are essential in managing dental anxiety in children. The technique of behaviour management must be individually tailored.

Distraction, a non-pharmacological technique, has proven effective in redirecting a child's focus away from anxiety-inducing stimuli<sup>9</sup>. In this in-vivo study, 80 children aged 6–8 years were divided into four groups: Group A (3D VR Glasses), Group B (Audio Distraction), Group C (POP-IT), and Group D (Control). Parameters such as pulse rate, oxygen saturation (SpO<sub>2</sub>), and Facial Image Scale (FIS) scores were used to assess anxiety levels.

The results demonstrated that the Virtual Reality Group showed a significant improvement in reducing anxiety as shown in the FIS scores, SpO<sub>2</sub> levels and pulse rate followed by the POP- IT group. Though the Audio

Distractor Group exhibited a significant difference before and after treatment, it was less effective than the virtual reality and the POP -IT groups.

Distraction techniques like VR glasses is based on the principle that pain perception decreases when attention is diverted<sup>10,11</sup>. VR offers immersive multisensory engagement, VR Group has consistently achieved a favourable response, significantly lowering anxiety and pain<sup>12</sup>. The results of the present study are in accordance with randomised controlled trials conducted by Sharma et al in 2021<sup>13</sup> and SG Greeshma et al 2021<sup>14</sup> where they found that VR distraction was significantly better than the audio distraction and TSD in children aged 6-8 years. A systematic review and meta-analysis conducted in 2024 also demonstrated that there was a significant reduction in anxiety and pain with the use of VR<sup>15</sup>. These results support the distraction theory which posits that immersive stimuli like VR can reduce anxiety by diverting attention away from aversive procedures in the dental clinic. Clinical evidence demonstrates that distraction techniques can successfully alleviate a child's dental fear and anxiety as, external stimuli from different senses can easily overload the child's focus and divert their attention from the dental treatment<sup>16-18</sup>. VR eyeglasses are available in various budgets and is easily available which further encourages the incorporation of VR into clinical dental practice. The utilization of VR in routine practice can reduce the reliance on pharmacological sedation, improve patient compliance and enhance the overall dental experience for children.

Play therapy using POP-IT toys resulted in notable but comparatively lower reductions in pain and anxiety than the VR eyeglasses. POP-IT toys acts by the tactile, repetitive, and rhythmic engagement, producing a calming effects through sensory stimulation and motor distraction<sup>19</sup>. However, the level of cognitive and sensory immersion achieved with POP IT toys is inherently less than that of VR distraction, potentially accounting for its relatively lesser efficacy. In addition, it was used in children aged between 6-8 years and was a simple repetitive action, hence could not engage the child throughout the procedure, however it may be effective in young children.

Audio distraction is recognized as an effective method of reducing anxiety and fear. Having patients choose music according to their preferences has a beneficial effect in reducing anxiety and fear<sup>5</sup>. Audio distraction promotes relaxation and reduced pain perception, undergoing dental extractions was stated in studies by Kim et al.,<sup>20</sup> and Singh et al<sup>21</sup>. However, the present study showed that though Audio distraction was effective, however it was less than the Virtual Reality and POP-IT toy.

Distraction is an important tool in behaviour management. The present study showed that Virtual Reality was more effective than the POP-IT toy and audio distraction. This emphasises the need for appropriate selection of distraction techniques based on the cognitive development of a child.

### Conclusion

The current study concluded that Virtual Reality was the most effective distraction technique, showing the highest improvements in SpO<sub>2</sub>, pulse rate, and FIS scores. This was followed by the POP-IT and audio group respectively which also showed significant reduction in anxiety.

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