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Original Research

Beyond Tell-Show-Do: Harnessing Virtual Reality to Enhance Cooperation and Reduce Anxiety in Paediatric Patients among 5-10 years of age.

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ABSTRACT:

Introduction: Dental anxiety in children continues to pose a challenge for pediatric dentists, often leading to negative behavior and difficulty in delivering effective care. Conventional non-pharmacological behavior guidance techniques such as tell–show–do (TSD) are commonly employed; however, newer immersive technologies like virtual reality (VR) may offer enhanced distraction and anxiety reduction. **Objective:** To evaluate and compare the effectiveness of a Virtual Show–Do (VSD) technique using VR with the traditional TSD method in reducing anxiety and improving treatment acceptance among pediatric dental patients. **Methods:** A randomized controlled trial was conducted on 40 children aged 5–10 years undergoing routine dental procedures. Participants were allocated to either the Virtual Show–Do (VSD) or Tell–Show–Do (TSD) group. Anxiety was assessed using heart rate, oxygen saturation, and a child-friendly Visual Analogue Scale (VAS). Data were analyzed using paired and independent t-tests and Chi-square tests. **Results:** Children in the VSD group demonstrated significantly better treatment acceptance, reflected by higher mean VAS scores compared to the TSD group ($p < 0.05$). Although inter-group differences in heart rate and oxygen saturation were not statistically significant, intra-group analysis revealed a significant improvement in post-operative oxygen saturation levels in the VSD group, suggesting reduced anxiety. The VR-based intervention was well tolerated and showed greater positive behavioral responses. **Conclusion:** Virtual Show–Do using VR appears to be an effective adjunct to conventional behavior management techniques, offering improved anxiety control and positive treatment experiences in children. VR may be considered a promising non-pharmacological tool for managing mild to moderate dental anxiety in pediatric patients.

Keywords: Pediatric dental anxiety; Virtual reality; Behavior management; Tell–Show–Do; Distraction techniques

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INTRODUCTION

Dentistry has advanced significantly in techniques and technologies, yet dental anxiety in children remains a persistent challenge. Studies show that dental fear and anxiety are prevalent among children, with reported rates ranging from about 23% to as high as 61.5% depending on age and assessment methods. This anxiety can act as a major barrier, making children reluctant to accept dental treatment and potentially impacting their oral health outcomes.[1] The pediatric dentist's role goes beyond treating the immediate dental concern; it also involves teaching children effective ways to manage their anxiety. Common nonpharmacological strategies used in dental practice to address anxiety include tell-show-do, modeling, reinforcement, voice control, nonverbal communication, and distraction. These approaches help create a more positive dental experience and support techniques long-term oral health in children.[2]

The tell-show-do technique is one of the most widely used nonpharmacologic behavior management methods in pediatric dentistry. It was first introduced by Addleston in 1959. In this approach, the dentist explains the procedure to the child using simple, understandable language, demonstrates the steps involved, and then performs the procedure exactly as described and shown. This technique helps reduce anxiety by making the child familiar with what to

expect, thereby fostering trust and cooperation during dental treatment.[3]

In recent years, there has been a notable rise in behavioral research utilizing virtual reality (VR) and virtual worlds. While VR was initially recognized mainly for entertainment, over the past decade its use has expanded into various clinical fields, including pain management and the treatment of psychiatric disorders.[4]

Therefore, this study seeks to build upon the conventional TSD approach by introducing a "Virtual Show-Do" (VSD) technique. The primary aim is to compare the efficacy of this VR-based intervention against the standard TSD method in reducing physiological anxiety and improving cooperative behaviour in children undergoing dental treatment.

MATERIAL AND METHOD

A randomized controlled trial (RCT) with two parallel arms was conducted to compare the effectiveness of the Virtual Show-Do (VSD) technique using Virtual Reality (VR) with the conventional Tell-Show-Do (TSD) method in reducing anxiety among paediatric dental patients.

A total of 40 children, aged 5–10 years, fulfilling the inclusion criteria, were randomly allocated into two groups:

- Group A (Intervention – Virtual Show-Do): n = 20
- Group B (Control – Tell-Show-Do): n = 20

Randomization was performed using a simple random allocation method.

Inclusion Criteria

- Children aged 5–10 years
- Frankl Behaviour Rating Score 2 or 3
- Requiring routine, non-surgical dental treatment
- Parental informed consent and child assent obtained

Exclusion Criteria

- Neurological or behavioural disorders
- History of epilepsy or vestibular dysfunction
- Visual or auditory impairments
- Active respiratory infections
- Children requiring emergency or complex dental procedures

Clinical Procedure

Baseline Assessment

All procedures were carried out in a standardized clinical environment. Each child was seated in the dental chair, after which a pulse oximeter was attached to the index finger to record baseline heart rate and oxygen saturation prior to initiation of any behavioural intervention.

Intervention Protocol

Group A: Virtual Show-Do (VSD)

Participants assigned to the VSD group were fitted with the VR headset and exposed to an interactive dental simulation vedio designed to familiarize the child with the instruments and procedural steps in a playful, immersive manner. The VR module replicated dental instrumentation, sounds, and movements while providing child-friendly animated guidance.[fig 1]

Group B: Tell-Show-Do (TSD)

Children in the control group were managed using the traditional Tell-Show-Do approach. The clinician provided verbal explanation (“Tell”), demonstrated the use of instruments and sensory cues (“Show”), and subsequently performed the clinical procedure (“Do”) without the use of any digital or audiovisual adjunct.[fig 1]

Treatment Execution

Following behavioural conditioning, the planned non-surgical dental procedure—such as oral examination, cleaning, or basic restorative care—was completed while the child continued in the assigned behavioural management condition (VR immersion or conventional TSD support).Immediately upon completion of treatment, the pulse oximeter readings were recorded again to obtain post-operative heart rate and oxygen saturation. Subsequently, each child was asked to rate their experience using the child-friendly Visual Analogue Scale (VAS).

Outcome Measures

Primary Outcomes

Change in physiological indicators of anxiety:

- Heart rate (pre- and post-operative)
- Oxygen saturation (pre- and post-operative)

Secondary Outcome

- Self-reported anxiety/treatment acceptance measured using the 5-point VAS.

Statistical Analysis

Data were analysed using parametric tests with a significance level set at $p < 0.05$. Intra-group comparisons of pre- and post-operative measures were performed using paired t-tests, while inter-group comparisons between VSD and TSD groups were evaluated using independent t-tests. Descriptive statistics were used to present mean values, standard deviations, and frequency distributions of VAS responses.

Figure 1: A & B – Intervention group
C & D -Control group

RESULTS

Table 1 depicts the age and gender distribution of the study participants in Group A and Group B. The table shows the number (n) and percentage (%) of children in each age category (5–10 years) and according to gender for both groups, as well as for the total study sample.

Regarding gender distribution, males constituted 32.5% (n = 13) of the total sample, while females comprised 67.5% (n = 27). In Group A, females predominated with 75% (n = 15), whereas males constituted 25% (n = 5). Similarly, in Group B, a higher proportion of females (60%, n = 12) was observed compared to males (40%, n = 8)

Table 2 depicts the distribution of anxiety levels assessed using the Visual Analogue Scale (VAS) among children in Group A and Group B. The table presents the number (n) and percentage (%) of participants categorized as very negative, negative, neutral, positive, and very positive, along with the comparison between groups using the Chi-square test.

In Group A, none of the children reported very negative or negative VAS scores. The majority of children demonstrated positive (50%) or very positive (45%) responses, indicating lower anxiety levels. Only 5% of participants in this group showed a neutral response.In contrast, Group B showed a higher proportion of unfavorable responses, with 10% of children each reporting very negative and negative scores, and20%exhibiting neutral responses. Positive and very positive responses wereobserved in group A [Graph 1]

Table 1 : Age and gender distribution of study sample

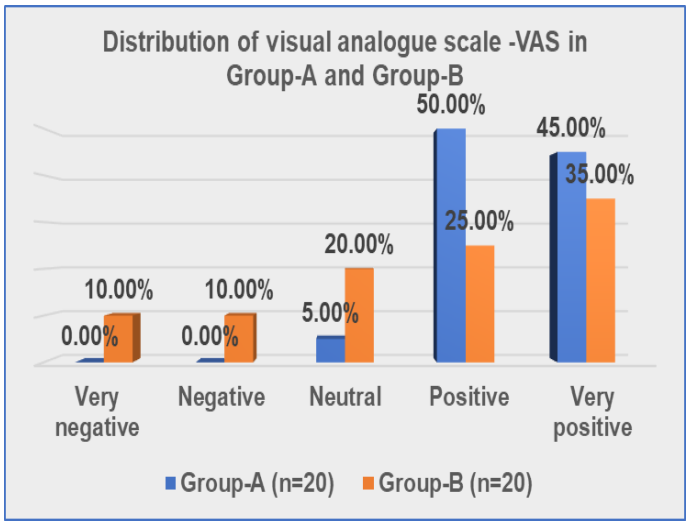
Particulars		Group-A (n=20)		Group-B (n=20)		Total (n=40)	
		n	%	n	%	n	%
Age in years	5	7	35.00	2	10.00	9	22.50
	6	3	15.00	3	15.00	6	15.00
	7	2	10.00	7	35.00	9	22.50
	8	1	5.00	2	10.00	3	7.50

	9	4	20.00	2	10.00	6	15.00
	10	3	15.00	4	20.00	7	17.50
Gender	Males	5	25.00	8	40.00	13	32.50
	Females	15	75.00	12	60.00	27	67.50

Table 2 : Distribution of visual analogue scale -VAS in Group-A and Group-B

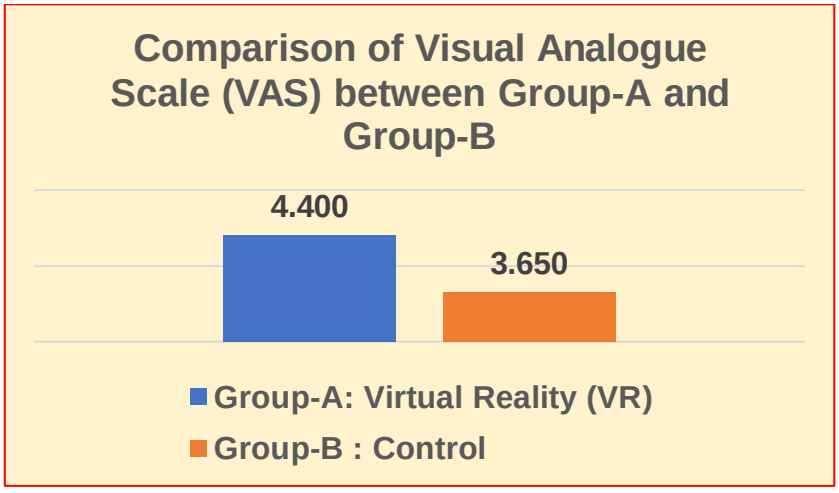
VAS score	Group-A (n=20)		Group-B (n=20)		Total (n=40)		p-value
	n	%	n	%	n	%	
Very negative	0	0.00	2	10.00	2	5.00	0.029
Negative	0	0.00	2	10.00	2	5.00	
Neutral	1	5.00	4	20.00	5	12.50	
Positive	10	50.00	5	25.00	15	37.50	
Very positive	9	45.00	7	35.00	16	40.00	

Test Applied: Chi-square *($p<0.05$)



Graph 1: Distribution of visual analogue scale -VAS in Group-A and Group-B

In inter-group comparison of mean VAS scores between Group A and Group B, Group A demonstrated a significantly higher mean VAS score (4.40 ± 0.59) compared to Group B (3.65 ± 1.35). The difference was statistically significant (independent t-test, p = 0.029), indicating lower anxiety levels in the virtual reality group compared to the control group [Graph 2].



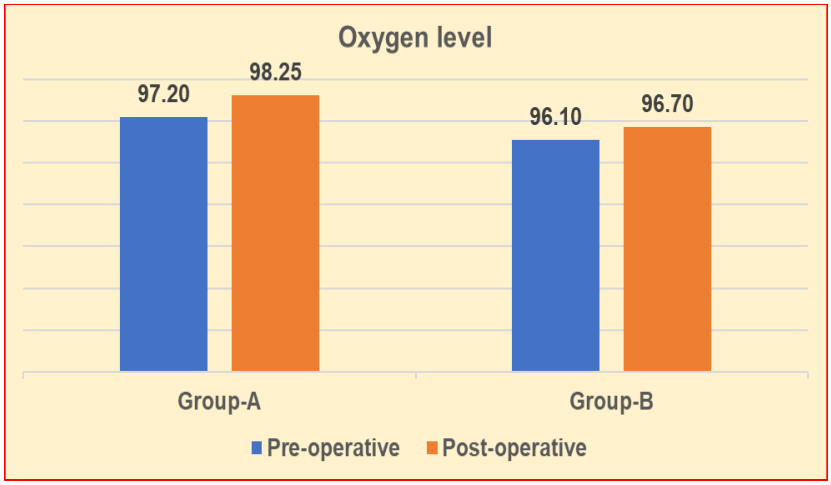
Graph 2: Comparison of Visual Analogue Scale (VAS) between Group-A and Group-B

Table 3 presents the inter-group comparison of mean heart rate values between Group A and Group B at pre-operative and post-operative time intervals. The mean heart rate did not differ significantly between the two groups at baseline (112.35 ± 16.98 bpm in Group A vs 103.75 ± 28.96 bpm in Group B; p = 0.259). Similarly, no

statistically significant difference was observed post-operatively (107.95 ± 16.05 bpm in Group A vs 107.60 ± 26.06 bpm in Group B; p = 0.959).

Table 3: Inter-group comparisons between Group-A and Group-B of heart rate at pre and post operative

Time intervals	Group	N	Mean	±SD	SEM	p-value	S/NS
Pre-operative	Group-A	20	112.35	16.98	3.80	0.259	NS
	Group-B	20	103.75	28.96	6.48		
Post-operative	Group-A	20	107.95	16.05	3.59	0.959	NS
	Group-B	20	107.60	26.06	5.83		



Graph 3: Intra-group comparisons between pre and post operative within Group-A and Group-B of oxygen (PO2)

Table 4: Inter-group comparisons between Group-A and Group-B of oxygen (PO2) at pre and post operative

Time intervals	Group	N	Mean	±SD	SEM	p-value	S/NS
Pre-operative	Group-A	20	97.20	2.31	0.516	0.197	NS
	Group-B	20	96.10	2.95	0.661		
Post-operative	Group-A	20	98.25	1.02	0.228	0.068	NS
	Group-B	20	96.70	3.54	0.792		

Table 4 depicts the inter-group comparison of mean oxygen saturation (SpO_2) levels between Group A and Group B at pre-operative and post-operative intervals. There was no significant difference in mean SpO_2 values between the groups at the pre-operative stage (97.20 ± 2.31% in Group A vs 96.10 ± 2.95% in Group B; p = 0.197). Post-operatively, oxygen saturation levels remained comparable between Group A and Group B (98.25 ± 1.02% vs 96.70 ± 3.54%, respectively), with no statistically significant difference (p = 0.068) [Graph 3].

Table 5 shows the intra-group comparison of mean heart rate values between pre-operative and post-operative time intervals within Group A and Group B. In Group A, the mean heart rate decreased from 112.35 ± 16.98 bpm pre-operatively to 107.95 ± 16.05 bpm post-operatively; however, this difference was not statistically significant (paired t-test, p = 0.108). Similarly, in Group B, the mean heart rate increased from 103.75 ± 28.96 bpm pre-operatively to 107.60 ± 26.06 bpm post-operatively, with no statistically significant difference observed (p = 0.278).

DISCUSSION

There is a well-established association between children's anxiety and uncooperative behavior, which can compromise the quality and effectiveness of dental care; therefore, reducing preoperative anxiety in children is essential.[1] Managing anxiety and behavior in pediatric patients often demands greater effort and skill from the dentist than the dental procedure itself.[5]

Distraction has long been utilized in dentistry, grounded in the understanding that pain perception is strongly influenced by psychological factors. By redirecting attention away from noxious stimuli, distraction leads to a marked reduction in perceived pain. Multiple studies have confirmed the effectiveness of distraction techniques in alleviating dental fear and anxiety in children, including those with special healthcare needs, during dental procedures.[6]

Tell-show-do is a widely used technique to familiarize the child with new procedures and reduce fear of the unknown. Numerous studies have shown that effective distraction involves stimulation of multiple

senses—such as hearing, vision, and touch—along with active emotional engagement to counteract anxiety-provoking stimuli.

In recent years, extensive research in behavioral science has focused on virtual reality (VR) and virtual environments. VR involves human interaction with computer-generated environments through sophisticated systems and diverts the patient's attention from the real world to a virtual one, enabling the child in the dental operatory to focus on the virtual environment. Sullivan et al. reported that the use of VR during dental treatment significantly reduced patients' pulse rates. Additionally, most studies have demonstrated a significant reduction in stress levels with VR-based distraction techniques.[3]

Children aged 5-10 years were included in the study to enable the effective application of behavior management techniques and to assess their impact on reducing dental treatment–related anxiety.Participants in the control group were managed using the conventional tell–show–do technique alone, whereas participants in the VRD group were provided with VRD eyeglasses. Complete occlusion of the visual field in the VRD group resulted in greater engagement and focus on the virtual environment rather than the clinical surroundings. Consequently, dental treatment could be performed more efficiently, with minimal need for additional behavior management during the procedure.

In the present study, pulse rate and oxygen saturation were recorded as physiological parameters, as they are simple, non-invasive, and easily assessed using a pulse oximeter without inducing anxiety in the child. Visual analogue scale(VAS) , an objective tool with high inter-rater reliability, was used to assess anxiety levels [fig 2]

The findings of the present study indicate that the use of VR distraction is effective in reducing pain perception and state anxiety levels in children during routine dental treatment. Oxygen saturation (SpO_2), used as an indicator of anxiety, demonstrated variable results, with an increase in SpO_2 reflecting a reduction in anxiety.

When we compared anxiety level i.e. VAS score between Group-A and Group-B, the mean score differ significantly (p=0.029). The VAS score is higher in Group-A (4.400) as compared to Group-B (3.650) which reveals that children are more positive with reduced anxiety level in Virtual reality group as compared to control group. Virtual reality group performed better as compared to control group in terms of reducing anxiety level among children.

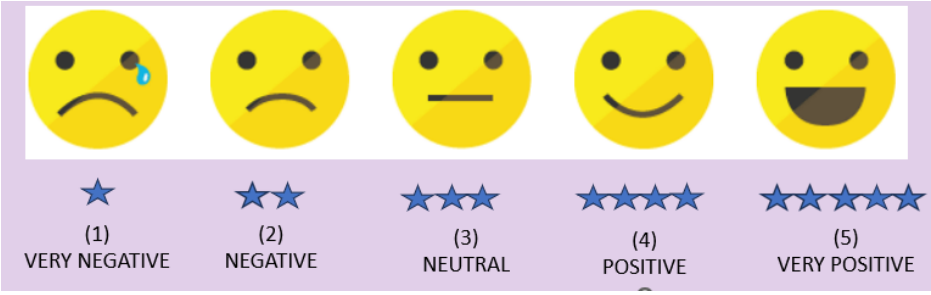


Figure 2: Visual Analogue Scale

The results align with those of Wiederhold et al. and Sullivan et al., who demonstrated the efficacy of virtual reality distraction in alleviating pain perception and anxiety.[7,8]

When we compared oxygen level between pre and post operative within Group-A and Group-B, the mean difference is significant in Group-A (p=0.043), while it is non-significant in Group-B respectively. The oxygen level is better at post-operative (98.25) than that of pre operative. The oxygen level may be improved due to positive anxiety among children after post operative.

Table 5: Intra-group comparisons between pre and post operative within Group-A and Group-B of oxygen (PO2)

Group	Time intervals	N	Mean	±SD	SEM	p-value	S/NS
Group-A	Pre-operative	20	97.20	2.31	0.516	0.043	S
	Post-operative	20	98.25	1.02	0.228		
Group-B	Pre-operative	20	96.10	2.95	0.661	0.448	NS
	Post-operative	20	96.70	3.54	0.792		

Studies by Asl Aminabadi et al., Rao et al., and Shetty et al. have concluded that VR distraction is effective in reducing pain perception and anxiety during various dental procedures, findings that are consistent with the results of the present study. Additionally, Suresh and George evaluated the effectiveness of VR distraction on dental anxiety and behavior in children with autism spectrum disorder and reported a significant reduction in anxiety scores along with improved dental behavior.[9-12]

Several studies have evaluated audiovisual distraction in pediatric dentistry, including the study by Mitrakul

et al., which assessed the effectiveness of video eyeglasses, and that by Ram et al., which examined the use of an audiovisual eyeglass system. Both studies reported a significant reduction in children's anxiety during dental procedures. However, some studies have also noted that the use of audiovisual eyeglasses may limit child–clinician interaction.[13,14]
Virtual reality comprises essential components such as a virtual environment, immersion, sensory feedback, and interactivity. VR-based distraction is distinct in its highly immersive and engaging nature, as it integrates multiple sensory modalities, thereby capturing a greater level of user attention. Additionally, VR creates the illusion of presence by enabling objects that do not exist in the real world to appear within a computer-generated virtual environment.[15]

Limitations of the study: Recent evidence suggests that excessive screen time may adversely affect neural circuits involved in traditional learning processes such as reading, writing, and concentration; consequently, the World Health Organization recommends limiting screen exposure. Although the present study explored the therapeutic and educational use of virtual tools, there remains a possibility that parents may misconstrue this as promoting increased screen use. Additionally, the relatively small sample size represents a limitation; inclusion of a larger sample in a routine clinical setting may have provided clearer differentiation in anxiety levels among various distraction aids. The exclusion of children with previous negative dental experiences may also be considered a limitation, as this could have influenced the outcomes. However, this criterion was deliberately applied to ensure a homogeneous study population and to enable more reliable conclusions.[3]

CONCLUSION

Virtual tools facilitate multisensory stimulation, engaging hearing, vision, and touch, while also promoting active emotional involvement to counteract anxiety-provoking noxious stimuli. In conjunction with findings from previous studies, the present results suggest that virtual tools may serve as a beneficial adjunct for managing mild-to-moderate dental fear and anxiety in children. Nevertheless, further research is warranted to more clearly delineate their full potential, effectiveness, and limitations.

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