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Original Research Article

Comparative evaluation of the effectiveness of 'Tell Show Do' (TSD) and Virtual Reality (VR) method of Behaviour management on anxiety levels of children undergoing restorative treatment of carious teeth: A randomised control study

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Abstract

Aim: To evaluate and compare the effectiveness of 'Tell Show Do' (TSD) and Virtual Reality (VR) method of Behaviour management on anxiety levels of children undergoing restorative treatment of carious teeth.

Materials and Methods: Sixty children belonging to the age group of 6-12 years having their first dental visit, with occlusal caries limited to enamel and dentin were included in our study. These children were randomly allocated to Group A (Tell Show Do) and Group B (Virtual Reality). Dental anxiety was assessed by Venham's Picture Test and pulse rate, pre-operatively and post-operatively to the primary tooth's restorative treatment.

Results: There was a statistically significant difference seen in anxiety values pre-operatively and post-operatively within Group A and Group B; whereas intergroup comparison showed no statistically significant difference.

Conclusion: It was found that the new technological Virtual reality method was as effective as the conventional, non-aversive, Tell Show Do method of behavior management. Virtual Reality can be surely considered as a promising tool in the wide field of behavior management techniques and can be clinically applied in managing dentally anxious patients while providing quality dental care.

Keywords: Behaviour, Child, Dental anxiety, Virtual reality.

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1. Introduction

Oral healthcare for children is an integral component of their general well-being; still it has been the most neglected one due to numerous reasons. The pain and anxiety can be the major confounding factors hampering the willingness of the patient to seek dental care. Mc Elroy rightly quoted "Operative dentistry may be perfect, but the appointment is a failure if a child departs in tears,"[1] thus if we try to understand the child's behavior first and try to modify it, then their cooperation can be achieved. Behavior management techniques hold a significant role in reducing anxiety and also in developing a positive dental attitude in the formative years of a Pediatric patient. Out of the various behavior management techniques available in the literature, the gold standard and widely accepted of them is the "Tell Show Do" technique given by Addleston in 1959.[2]

Another widely accepted method is Distraction; an effective, inexpensive, non-invasive method of behavior management that helps the patient in having a relaxed experience in dental procedures. McCaul and Mallet stated that an individual needs to concentrate on the painful stimuli in order to perceive pain; therefore, perception of pain decreases when a person's attention is distracted away from the stimulus.[3]

The ways in which the distraction principle is applied have also evolved with advancements in technology. In recent times, there has been an upsurge in exploring the

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potential of Virtual Reality (VR) and the Virtual world. VR denotes a human-computer interface that allows the user to interact actively with the virtually simulated environment. VR uses head-mounted displays (HMDs) and three-dimensional systems in order to make the experience more immersive in nature.[4]

VR is specifically attractive for children as they turn out to be really charmed by imaginative play and get immersed in virtual presence rather than the surroundings in reality around them.[5] Beyond providing a distraction, it is said that VR also helps in alleviating pain and anxiety; but when the literature search was carried out there were very few studies in Indian scenarios and worldwide regarding evaluating the effectiveness of Tell Show Do (TSD) and Virtual Reality (VR) method of Behaviour management on anxiety levels of children undergoing restorative treatment of carious teeth. So, an attempt is made to carry out this research to evaluate the effect of Virtual Reality technology on anxiety levels in children during the restoration of primary teeth.

2. Materials and Methods

2.1. Clinical trial registry

The study has been registered prospectively under the Clinical Trials Registry – India (CTRI) with the CTRI number of CTRI/2020/12/029531.

2.1.1. Guidelines

The study has intended to improve the reporting of parallel-group randomized controlled trials by following CONsolidated Standards of Reporting Trials (CONSORT) guidelines. (**Figure 1**)

60 children from the age group of 6-12 years on their first dental appointment having caries limited to enamel and dentin with an ICDAS score 4 and 5, willing to participate, were selected for our study. Children requiring pulp therapy or invasive procedures, children with special health care needs, and children who declined to participate were eliminated from our research. The required sample size for the study was calculated according to the standard sample size calculating formula.[1]

The participants included in our study were randomly divided, by picking a chit from a box, into Group A (Control group) and Group B (Experimental group) in which their behaviour, during restorative treatment, was managed by using Tell Show Do and Virtual Reality respectively. Virtual Reality gadget [Samsung Gear VR SM-322NZWAINU, Samsung Electronics Vietnam Co., Ltd] was used for the children to watch Disney VR in our study. Venham's picture test and pulse rate readings using a pulse oximeter [CONTEC ™ CMS50dl IP22] were assessed pre-operatively and post-operatively for assessing children's anxiety.

3. Results

A total of 60 patients were included in the study, of them 60% were males and 40% were females. In Group A, males and females were 50% each and in Group B they were 70% and 30% respectively. The intergroup comparison by Chi-square test showed no statistically significant difference in the gender distribution. (p=0.1150) The mean age of Group A and Group B were 8.23 and 7.93 respectively, showing no statistically significant difference between the two groups by Independent t-test (p=0.5248).

The Kolmogorov Smirnov test showed that the values of Group A and Group B do not follow a normal distribution, hence the non-parametric tests, Mann-Whitney U test, and Wilcoxon matched-pairs test were used for Inter-group and Intra-group comparison respectively (p<0.05).

The Intergroup comparison of anxiety by Venham's Picture Test (**Table 1**) and Pulse rate (**Table 3**) between Group A and Group B, is found to be not significant by the Mann-Whitney U test (p= 0.496) whereas on Intragroup comparison of Venham's Picture Test (**Table 2**) and Pulse rate (**Table 4**) within Group A and Group B by Wilcoxon matched-pairs test is found to be statistically significant in both groups (p=0.0001*).

A correlation test between the changes in Venham's picture test and Pulse rate in Group A and Group B by Spearman's rank correlation test was done (**Table 5**); a positive correlation was found in Group A and Group B. The 'p'-value for Group A was found to be statistically significant (p=0.498*).

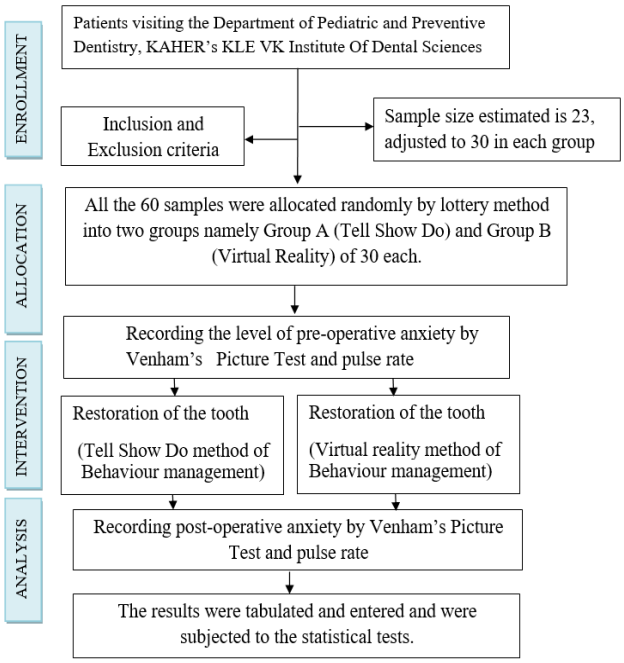

Figure 1: CONSORT Flowchart showing methodology followed in the study

Table 1: Intergroup comparison of Venham's picture test between Group A and Group B by Mann-Whitney U test.

Treatment times	Group A				Group B				U-value	Z-value	P-value
	Mean	SD	Median	IQR	Mean	SD	Median	IQR			
Pre-operative	2.20	1.52	2.00	1.0	1.80	1.10	1.00	1.00	396.0	0.791	0.429
Post-operative	0.67	0.80	0.50	0.5	0.70	0.75	1.00	0.50	431.0	0.273	0.784
Difference	1.53	1.11	1.00	0.5	1.10	0.80	1.00	0.63	353.5	1.419	0.155

*p<0.05; Mann-Whitney U test

Table 2: Intragroup comparison of Venham's picture test values within Group A and Group B by Wilcoxon matched pairs test.

Groups	Time points	Mean	SD	Mean Diff.	SD Diff.	% of change	Z-value	P-value	Effect size
Group A	Pre-operative	2.20	1.52						
	Post-operative	0.67	0.80	1.53	1.11	69.70	4.4573	0.0001*	0.6650
Group B	Pre-operative	1.80	1.10						
	Post-operative	0.70	0.75	1.10	0.80	61.11	4.1973	0.0001*	0.6600

*p<0.05; Wilcoxon matched pairs test

Table 3: Intergroup comparison of Pulse rate between Group A and Group B by Mann-Whitney U test.

Treatment times	Group A				Group B				U-value	Z-value	P-value
	Mean	SD	Median	IQR	Mean	SD	Median	IQR			
Pre-operative	102.67	12.3	99.00	7.1	106.2	12.9	101.0	7.2	370.5	-1.168	0.242
Post-operative	98.73	10.8	98.00	2.0	102.5	8.91	99.0	7.1	362.0	-1.293	0.195
Difference	3.93	11.2	2.00	1.8	3.70	6.91	2.0	2.6	403.5	-0.680	0.496

*p<0.05; Mann-Whitney U test

Table 4: Intra group comparison of Pulse rate within Group A and Group B by Wilcoxon matched pairs test

Groups	Time points	Mean	SD	Mean Diff.	SD Diff.	% of change	Z-value	P-value	Effect size
Group A	Pre-operative	102.67	12.37						
	Post-operative	98.73	10.86	3.93	11.23	3.83	2.8350	0.0046*	0.1130
Group B	Pre-operative	106.23	12.90						
	Pre-operative	102.53	8.91	3.70	6.91	3.48	3.4836	0.0005*	0.2290

*p<0.05; Wilcoxon matched pairs test

Table 5: Correlation between the changes in Venham's picture test and Pulse rate in Group A and Group B by Spearman's rank correlation test.

Groups	Variable	R-value	p-value
Group A	Venham's Picture Scale	0.3612	0.498*
	Pulse Oximeter		
Group B	Venham's Picture Scale	0.2075	0.2716
	Pulse Oximeter		

*p<0.05; Spearman's rank correlation test

4. Discussion

In our study, we found that both Tell Show Do and Virtual Reality methods are equally efficient in reducing the anxiety of children during restorative treatment. Both groups showed statistically significant differences in anxiety pre-operatively and post-operatively.

Dental anxiety has stood fifth among the most feared situations.[5] In a cross-sectional study conducted by Kumar et al., 61.5% of children have shown severe dental anxiety.[7] Given its high prevalence, we certainly expect that children with high dental anxiety often avoid dental care and may have high DMFT scores as projected in a systematic review and meta-analysis conducted by Janakiram et al, the mean

prevalence of dental caries in 5–12-year-old Indian children was 49%.[8] We have come a long way from neem sticks to smart toothbrushes; despite all these efforts, the major roadblock is supposedly the anxiety associated to the dental environment and procedures carried out.

The management of an anxious patient depends on several factors like age, estimated degree of cooperation, and their medical/dental history; to add to this, if we use a multi-layered approach rather than relying on a single method, helps us to improve the management of an anxious patient.[9] The widely used behavior management technique especially for the first visit of a child is the "Tell Show Do" (TSD). This is a very simple technique and can be used with children to deal with pre-existing anxieties and fears, or with patients having their first dental visit.[10] Thus, in our study, we used Tell-Show-Do method for the children included in the control group (Group A).

Audio-visual distraction (AVD) is a simple and effective method for easing anxious children through their dental experience. Virtual Reality (VR) is a computer-generated user interface, it allows the user to interact with the virtually created environment. VR is expected to be superior to less technologically advanced AVD methods.[11] Therefore, we used VR in our study and compared it with the TSD method of behavior management.

In our study, we evaluated dental anxiety of children belonging to the age group of 6-12 years of age. As stated by Piaget, this is approximately the third major developmental stage of cognition, i.e., the stage for concrete operations. During these years, mental representations of actions become a part of a child's cognitive abilities. Thus, these children can easily understand the Tell Show Do method of behavior management. Piaget also specified that children in this age group acquire the ability to understand reliabilities between length, mass, number, and weight despite their external differences. Relativeness also develops in the child's calculation system during this age.[12] Considering all these facts, children between the age group of 6-12 years were selected for our study as they would also understand the immersive nature of Virtual Reality.

Dental anxiety was assessed by using both subjective and objective measures, i.e., the Venham's Picture Test and Pulse rate respectively in our study. Venham's Picture Test (VPT) is a self-reporting, pictorial scale used to measure situational anxiety for young children. Advantages of using VPT are it is very simple, easily understood and rapidly administered.[13] The time of assessment of dental anxiety also holds an important role which can affect the outcomes. A systematic review revealed that dental anxiety was most widely assessed prior and after the dental treatment.[14] Pulse rate is governed by the Autonomic Nervous System (ANS). Physiological responses like heart rate, body temperature, respirations vary in presence of negative emotions.[15] Hence, pulse rate was also measured in conjunction with the self-reported anxiety scale.

To rule out the effect of confounding variables on dental anxiety we included patients having their first appointment for their dental care. With a view on dental anxiety, there can be a feeling of apprehension of probable pain, distress, or threat during treatment in spite of no prior experience.[14]

Numerous studies have demonstrated that cortical areas which are associated with attentional processes and pain modulation are more active during distraction technique, whereas the less attentive areas are those associated with painful stimuli.[4,16,17]

Riva et al. stated that in order to achieve the profits of VR therapy, presence alone is necessary but not sufficient.[17] Riva discussed that VR is so unique in its technology, works on the same basic mechanism of the brain: embodied simulations.[19,19] According to neuroscience, the brain creates an embodied simulation of the body in the world; this body is used to represent and predict emotions and actions based on the concepts and emotions learned throughout life.[21] Thus, in this view, VR can be defined as an "embodied technology" since it has the likelihood of altering the embodiment experience of the users.[22,23,24,25]

Our findings were in accordance to previous studies conducted by Rangel et al.[28] Sullivan et al.[29] and Wiederhold et al.[30] which showed that VR was equally efficient when compared with traditional non-aversive methods of behaviour management; whereas other studies showed that there was a positive effect of VR on physiological measures[4,25,29] and it could be possibly used as a credible distraction behaviour management method for reduction of dental anxiety in children.[15,27,31]

There are certainly additional advantages to the use of VR which include ease of use, greater control, and its frequent application does not affect its positive efficacy. Apart from these advantages, we also faced some difficulties during the use of VR in our study, some children were not as accepting to its use as other children and hence they were excluded from our study. The size of the VR also posed to be an issue for some younger children, who could not accommodate it properly even with the help of head straps.

VR gadget blocked out the clinical setting which may be anxiety-provoking for some and instead gave them a pleasant scene on the VR screen, this may lead to a reduction in anxiety levels,[26] but some children may feel blinded by the VR gadget thus adding on to the child's anxiety by increasing the fear of the unknown.[27]

Our study concluded that Virtual Reality was as effective as Tell Show Do method of behaviour management. Both TSD as well as VR showed a statistically significant decrease in anxiety levels post-operatively. VR is the new addition to distraction techniques described in the literature, thus we

conclude that more studies should be conducted to discover the unexplored potential of this new immersive technology. This will help in managing the dental anxiety of children and also help in increasing their oral health-related quality of life.

5. Limitations

The study was conducted among children from 6-12 years of age, however children belonging to different age groups may portray different cognitive behaviors towards the use of VR. Thus, future studies can be conducted assessing different age groups. Another limitation is the smaller sample size, studies with a larger sample size would be beneficial for generalizing the use of VR in effective behavior management of anxious children.

6. Ethical Committee Approval

The present randomized control study was conducted in the Department of Pediatric and Preventive Dentistry, KLE Academy of Higher Education and Research, KLE VK Institute of Dental Sciences, Belagavi. Ethical clearance for the study was obtained from the Institutional review board (Sl. No. 1394).

7. Funding of Sources

None.

8. Conflicts of Interest

None.

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