ORIGINAL RESEARCH

Effectiveness of Two Types of Distraction Techniques in the Management of Pain and Anxiety during Dental Treatment in 6–9-year-old Children

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Abstract

Aim: To determine the effectiveness of distraction with virtual reality (VR) distraction devices in comparison with mobile phone video games in the management of pain and anxiety during dental treatment in 6–9-year-old children.

Materials and methods: It was a comparative observational study. A total of 33 children aged 6–9 years who reported to the department for their first dental visit were selected and the subjects were divided into three groups. Group I patients were in a normal clinical environment without any distractions. Group II patients were given mobile phone video games. Group III patients were given a VR distraction device as a means of distraction.

The anxiety levels of patients before treatment, after using a distraction device preoperatively, during local anesthesia injection, and after dental treatment were assessed. Pain after local anesthesia injection in each group was assessed. The easability of handling the patient and carrying out the procedure was assessed using a questionnaire. All data were collected and analyzed.

Results: The results showed when compared to the children in groups I and II, children in group III obtained significantly lower anxiety scores after treatment, and they also reported significantly decreased pain perception during dental treatment ($p < 0.001$). The pain while administering local anesthesia was greater for the control group and lowest for the VR group. It was observed that VR group patients were easier to handle and easier to carry out procedures than those in the mobile phone group.

Conclusion: Virtual reality distraction is an effective distraction technique for reducing pain and anxiety in children during various treatment procedures.

Clinical significance: Virtual reality distraction can be used effectively in clinics.

It is a patient-friendly technique and is more comfortable for both patients and dentists during treatment.

It does not require any previous education and training and has a positive impact on memories of the treatment, leading to behavior modification.

Keywords: Anxiety, Pain, Virtual reality distraction.

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Introduction

Anxiety among pediatric patients is a great challenge posed to every dentist in everyday dental practice.[1] Pain and anxiety are inextricably related to the patient's experience. To reduce anxiety and pain in anxious children, several management strategies have been proposed.

One of the most commonly used behavior management techniques to manage pain and anxiety in children during dental procedures is the distraction technique.[2] Distracters can either be in active or passive form. In passive distraction, the child receives distracting stimuli from observation, such as watching television, listening to music, or watching cartoons using audiovisual eyeglasses. Active distraction includes the participation of the child, like playing video games on mobile phones. Virtual reality (VR) is a head-mounted visor that can be connected to a personal computer or a mobile phone. VR distraction device has the potential to engage both visual and hearing sensations and reduce memories during the procedure. Different distraction modalities have been discussed in the literature to reduce pain and anxiety in pediatric patients.[3–9]

So, this study focused on determining the effectiveness of distraction with VR distraction devices in comparison with mobile phone video games in reducing pain and anxiety during dental treatment in 6–9-year-old children.

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Materials and Methods

The study was conducted in the Department of Pediatric and Preventive Dentistry. The study design had been approved by the Institutional Ethics Committee. A sample of 33 children aged

6–9 years who reported to the department for their first dental visit were selected and informed consent was obtained from the parents of the children. Assent was obtained from children who were participating in the study. VR distraction devices (Procus ONE, Procus VR, Miracle Studios Private Limited) were used for the study.

Inclusion Criteria

- Patients who require dental treatment under local anesthesia.
- Patients who display evidence of slight negativism (Frankel's behavior rating II).
- Patients who know how to play mobile phone video games.
- Patients of age-group between 6 and 9 years.
- Children whose scores were <25 on screen for child anxiety-related disorder (SCARED) questionnaire.[10,11]

Exclusion Criteria

- Children with a history of definitively negative dental behavior (Frankel's behavior rating I) during dental treatment.
- Children with a history of any systemic diseases.
- Children who are physically and mentally challenged or have any visual and auditory impairment.

The selected children were screened by the outpatient department based on their scores on the SCARED questionnaire.[11] A child with a score below 25 was selected for the study. The subjects were divided into three groups:

- Group I patients in a normal clinical environment without any distractions.
- Group II patients were given mobile phone video games.
- Group III patients were given a VR distraction device as a means of distraction.

Procedure

Children belonging to group I (the control group) were given conventional behavior management techniques (such as Tell-Show-Do, conventional distraction, voice control, etc.). Before starting the treatment, patients in group II were allowed to play video games on mobile phones for 5 minutes, and children were asked to continue the game till the end of the dental procedure. Similarly, group III patients were given a VR distraction device and were asked to continue watching their favorite cartoons during the dental treatment. The distraction devices were removed after the treatment was completed.

Anxiety levels of patients before treatment, after using a distraction device preoperatively, during local anesthesia injection, and after treatment in each group were assessed using the facial image scale. Pain after local anesthesia injection in each group was assessed using the color analog scale in all three groups. The easability of handling the patient (preoperatively and during the procedure) and carrying out the procedure was assessed using a questionnaire.[12]

The data that was collected was analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0. The *p*-value was fixed at (probability that the result is true) <0.05. The statistical tools used were the Wilcoxon signed-rank test, Mann–Whitney *U* test, and Kruskal–Wallis test.

Results

The anxiety among the three groups was assessed by the facial image scale. The mean anxiety level in the first group (control) before treatment was 3.55 ± 0.522, and for the mobile phone group, it was 3.36 ± 0.505, and for VR, distraction was 3.27 ± 0.467, and there was no statistically significant difference at $p > 0.005$ (Table 1 and Fig. 1).

The mean anxiety level in the first group after using a distraction device preoperatively in groups II and III was 2 ± 0.00. The difference is not statistically significant (Table 2 and Fig. 2).

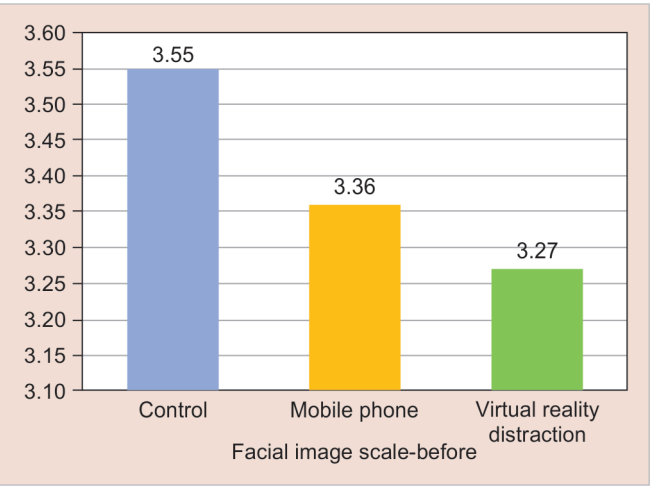

Fig. 1: Comparison of mean anxiety of three groups before treatment

Table 1: Mean anxiety levels of patients in groups I, II, and III before treatment

Facial image scale	*Groups*	*N*	*Mean*	*Standard deviation*	*Standard error mean*	*p-value*
Before	Group I (control)	11	3.55	0.522	0.157	**0.436**
	Group II (mobile phone)	11	3.36	0.505	0.152	
	Group III (VR distraction)	11	3.27	0.467	0.141	

*, significant at the 0.05 level using the Kruskal–Wallis test; Bold numbers indicate statistically significant values

Table 2: Mean anxiety levels of patients in groups I and II after using distraction device preoperatively

Facial image scale	*Groups*	*N*	*Mean*	*Standard deviation*	*Standard error mean*	*p-value*
After using a distraction device, preoperatively	Group II (mobile phone)	11	2.00	0.000	0.000	–
	Group III (VR distraction)	11	2.00	0.000	0.000	

During treatment, the highest anxiety was recorded in the control group, followed by the mobile phone group, and the lowest in the VR distraction group. There was no significant difference in the first group (control) during treatment. The difference was statistically significant for the mobile phone group and VR group ($p < 0.001$) (Table 3 and Fig. 3).

The highest mean value of anxiety after treatment was reported in the control group (3.18 ± 0.405), and the lowest was obtained in the VR group (2.00 ± 0.000). The difference was observed to be statistically significant for the mobile phone group and VR group ($p < 0.005$) (Table 4 and Fig. 3). The percentage of anxiety levels recorded before, during, and after treatment was obtained (Fig. 4).

Pain during local anesthetic administration in the present study was assessed using a color analog scale. The pain during local anesthesia administration was greater for the control group (7.14 ± 0.81) and lowest for the VR group (1.41 ± 0.58). There was a statistically significant difference at $p < 0.005$ (Table 5 and Fig. 5).

The ease of handling patients was greater in the VR group than in the other two groups. Both the distraction techniques had a statistically significant difference preoperatively and during the procedure ($p < 0.005$) (Table 6 and Fig. 6).

The ease of carrying out the procedure with distraction was compared between groups II and III using the Mann–Whitney *U* test. The mean value for group II was 3.18 ± 0.405, and group III was 2.00 ± 0.00. The difference was statistically significant in ease of carrying out procedures in these two groups ($p < 0.005$) (Table 7 and Fig. 7).

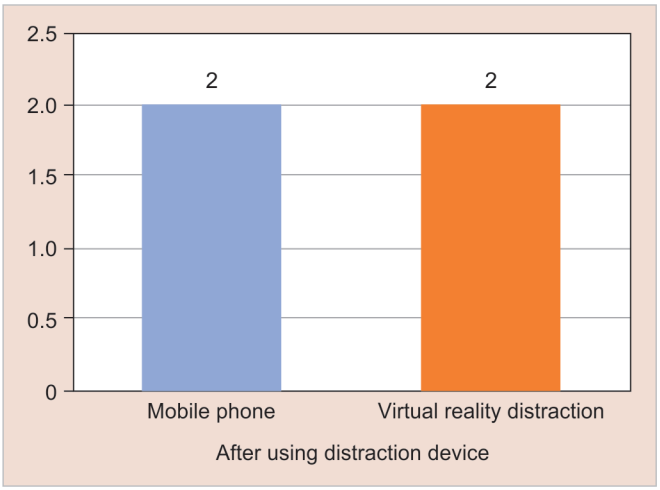

Fig. 2: Comparison of mean anxiety level after using distraction device preoperatively in two groups

Discussion

When the child is consciously attentive in one particular environment, the perception of pain increases. Dental anxiety is one of the prime concerns for dentists during pediatric procedures, and to reduce distress, many strategies have been proposed and discussed in works of literature.

In this study, it was observed that lower anxiety scores were present in group III children after treatment when compared to groups I and II, which clearly demonstrates the effectiveness of VR distraction in reducing anxiety in children.

This similar result was present in a study by Asl Aminabadi et al.[13] and Shetty et al.[11] However, the results were not consistent

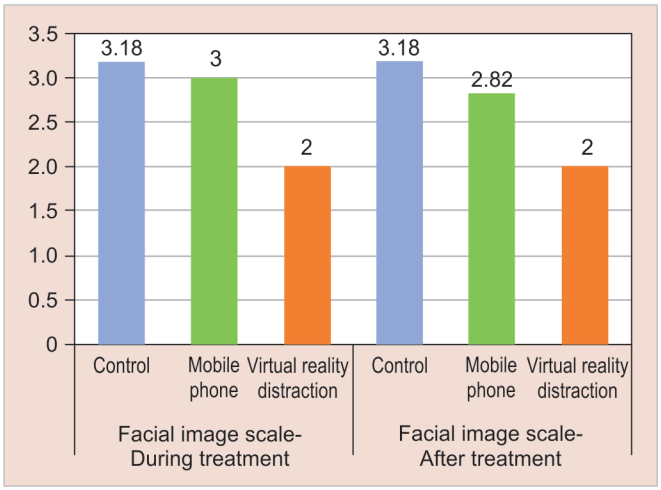

Fig. 3: Comparison of mean anxiety in three groups during and after treatment

Table 4: Intergroup comparison during and after treatment in groups I, II, and III

Facial image scale	*Variable*	*p-value*
During treatment	Control group	**1.000**
	Mobile phone group	**0.001***
	VR distraction group	**0.001***
After treatment	Control	**0.372**
	Mobile phone	**0.001***
	VR distraction	**0.001**

*, significant at 0.05 level using Mann–Whitney *U* test with Bonferroni correction; Bold numbers indicate statistically significant values

Table 3: Mean anxiety levels of patients in groups I, II, and III during and after treatment

Facial image scale	*Groups*	*N*	*Mean*	*Standard deviation*	*Standard error mean*	*p-value*
During treatment	Group I (control)	11	3.18	0.405	0.122	**0.001***
	Group II (mobile phone)	11	3.00	0.000	0.000	
	Group III (VR distraction)	11	2.00	0.000	0.000	
After treatment	Group I (control)	11	3.18	0.405	0.122	**0.001***
	Group II (mobile phone)	11	2.82	0.405	0.122	
	Group III (VR distraction)	11	2.00	0.000	0.000	

*, significant at 0.05 level using the Kruskal–Wallis test; Bold numbers indicate statistically significant values

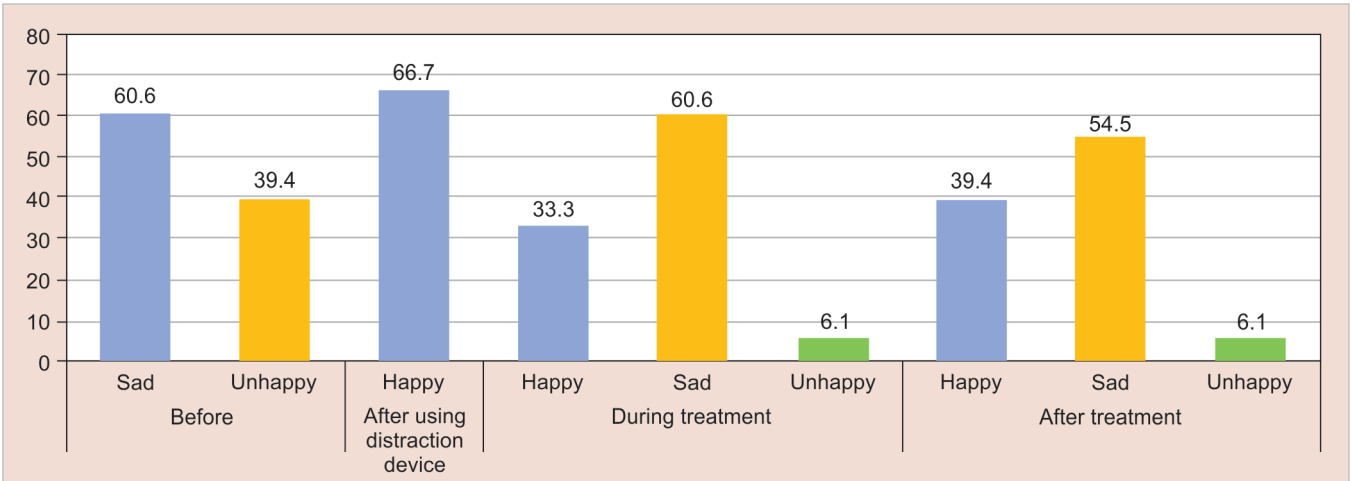

Fig. 4: Percentage of anxiety recorded before, during, and after treatment in three groups

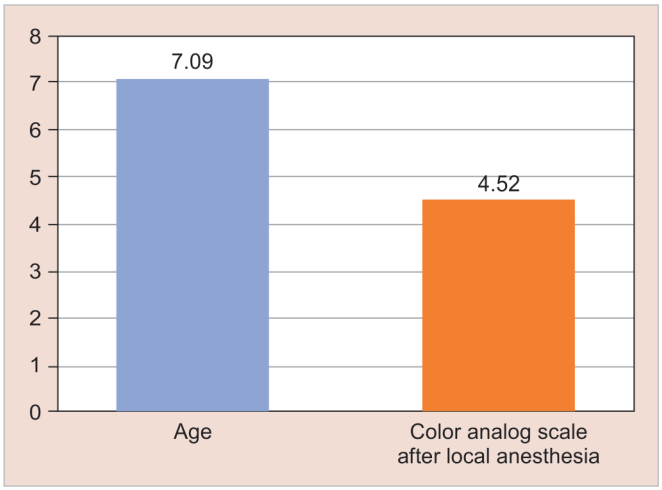

Fig. 5: Comparison of pain scores in three groups after administration of local anesthesia using a color analog scale

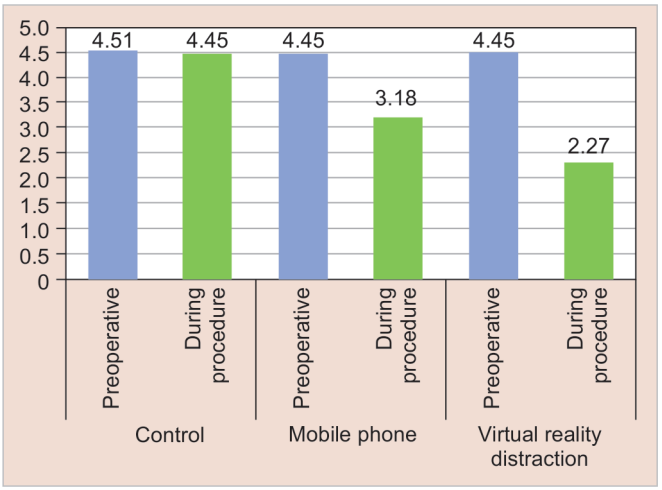

Fig. 6: Comparison of ease of handling patients in three groups

Table 5: Distribution of pain scores in groups I, II, and III after administration of local anesthesia

Variable	*Groups*	*N*	*Mean*	*Standard deviation*	*Standard error mean*	*p-value*
Color analog scale after local anesthesia	Control	11	7.14	0.81	0.24	**0.001***
	Mobile phone	11	4.95	0.72	0.22	
	VR distraction	11	1.41	0.58	0.18	

*, significant at 0.05 level using the Kruskal–Wallis test; Bold numbers indicate statistically significant values

Table 6: Ease of handling patients in groups I, II, and III

Groups	*Ease of handling patients*	*N*	*Mean*	*Standard deviation*	*Standard error mean*	*p-value*
Control	Preoperative	11	4.51	0.321	0.157	**0.217**
	During procedure	11	4.45	0.522	0.157	
Mobile phone	Preoperative	11	4.45	0.522	0.157	**0.001***
	During procedure	11	3.18	0.405	0.122	
VR distraction	Preoperative	11	4.45	0.688	0.207	**0.001***
	During procedure	11	2.27	0.467	0.141	

*, significant at the 0.05 level using the Wilcoxon signed-rank test; Bold numbers indicate statistically significant values

Table 7: Ease of carrying out the procedure with distraction

Variable	*Groups*	*N*	*Mean*	*Standard deviation*	*Standard error mean*	*p-value*
Ease of carrying out procedure with distraction	Mobile phone	11	3.18	0.405	0.122	**0.001***
	VR distraction	11	2.00	0.000	0.000	

*, significant at 0.05 level using Mann–Whitney *U* test; Bold numbers indicate statistically significant values

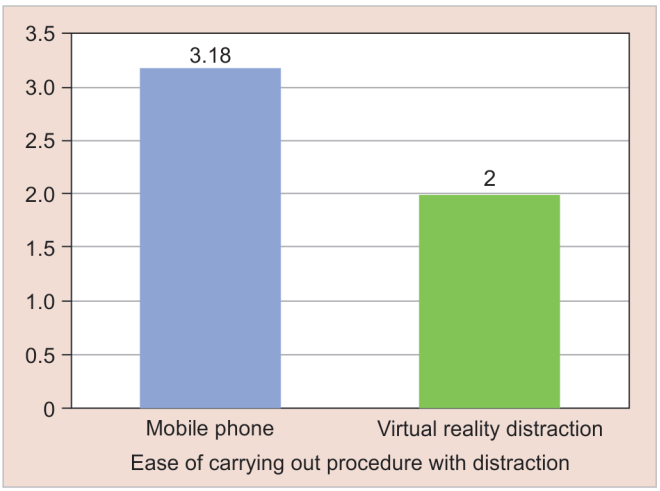

Fig. 7: Comparison of ease of carrying out the procedure in groups II and III

with those of a study conducted by Venham et al.[14] and Sullivan et al.,[15] which showed that VR or audiovisual distraction had no significant effect on the behavior or anxiety of children.

The facial image scale for measuring anxiety showed significant values in all three groups before treatments. This result showed similarity with the study conducted by Khotani et al.[16] and Filcheck et al.,[17] where the difference in facial image scale before, during, and after treatment was significant.

Prabhakar et al.,[18] Ram et al.,[19] and Seyrek et al.,[20] in their study, concluded that AV eyeglasses were effective in the management of anxiety during dental procedures. A similar result was observed by Nuvvula et al.,[21] Guinot Jimeno et al.,[22] Nunnaet et al.,[23] and Khandelwal et al.[24]

The pain during local anesthesia administration was greater for the control group and lowest for the VR group. A similar result was found in a study by Asl Aminabadi et al.,[13] El-Sharkawi et al.,[25] and Guinot Jimeno et al.[22]

These results were inconsistent with the study conducted by Attar and Baghdadi[26] and Patel et al.[27]

Mitrakul et al.[28] concluded that AV eyeglasses reduced pain and anxiety during dental treatment. A similar result was observed by Niharika et al.,[27] Buldur et al.,[29] and Bansal et al.[30] in their studies.

The easability of carrying out the procedure was higher in the VR distraction group than in the mobile phone video game group. This result is not in accordance with the study conducted by Sindhura et al.,[12] who concluded that carrying out the procedure using active video game distraction is easier than watching cartoons.

From the above interpretations, it can be concluded that VR distraction is one of the effective techniques in reducing the perception of pain and anxiety levels in children during dental treatment.

Clinical Significance

- Virtual reality distraction can be used effectively in clinics.
- It is a patient-friendly technique and is more comfortable for both patients and dentists during treatment.
- It does not require any previous education and training and has a positive impact on memories of the treatment, leading to behavior modification.

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