Original Research Article

Distraction: A game changer-A comparative interventional study in children aged between 4-7 years

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ABSTRACT

Introduction: Nowadays, various novel techniques have been documented to modify behaviour of the child and reduce dental anxiety in paediatric patients. Recently developed distraction methods have advancements that involve intellectual distraction games. This approach enables the clinicians to treat children with minimal resources and is readily accessible in the market. Several studies have also evaluated the productiveness of virtual reality (VR) as an audio-visual distraction aid in guiding anxious children.

Aim: The aim of the present study was to compare and evaluate the effectiveness of virtual reality eyeglasses vs intellectual colored game as a distraction aid to reduce anxiety of children undergoing dental procedure.

Materials and Methods: This was an in vivo interventional comparative study. A total sample of 90 children was selected aged between 4-7 years. They were randomly divided by chit method into three different groups with 30 children in each group: Group I (Control), Group II (VR) and Group III (ICG). Child's anxiety level was assessed using a combination of physiological parameter (pulse rate and oxygen saturation) and behavioral measures including subjective assessment (Venham's anxiety rating scale) and objective assessmemt (Facial Image Scale). Data was analysed using Statistical Package for Social Sciences (SPSS) version 21, IBM Inc.

Results: The study displayed a high statistically significant reduction in anxiety with VR & ICG Group when compared to Control group (p<0.001)

Conclusion: Mental distraction (Intellectual coloured game) was proven to be a more promising distraction aid due to certain limitations of Virtual reality distraction.

1. Introduction

Oral health is an integral aspect of children's health. Numerous studies have found that fear of pain and dental anxiety has been the foremost reason children avoid going to the dentist.[1] In a study conducted by Vinod Kumar et al., among South Indian children aged 6-12 years, the prevalence of dental anxiety in children was seen to be high (84.4%).[2] Thereby, to reduce stress during dental treatment, behaviour management strategies can be incorporated which are broadly divided into two categories. The conventional techniques include non-pharmacological behavioural techniques (distraction, tell-show-do, modelling, desensitisation etc.) and pharmacological techniques.[3,4]

Pain perception is a complex and multifaceted construct, and various factors such as sensory, emotional and cognitive processes can modulate the experience of pain in children.[5] Literature has shown that distraction seems to be a safe, potentially effective, feasible method to reduce anxiety in

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short invasive dental procedures.[6–8] The implementation of distraction is largely based on the concept of withdrawing patient's attention away from the noxious stimuli during the dental procedure. According to McCaul and Mallet, in order to perceive pain, an individual has to concentrate on the pain inducing stimuli.[9] Hence, when a child is distracted from the stimulus, pain perception is reduced.

Recently, advances in behaviour management research have led to the progression of Virtual Reality distraction. It refers to a human-computer functionality which helps the person to immerse in a stimulated environment with the help of computer-generated setting. It uses a head-mounted video glasses which integrates video storage, display and sound in one digital transmission.It enables the patients to see what is going on in the virtual world and thus distracts them from painful dental experience.

Another innovative behaviour management approach known as Mental distraction is popularly being used which makes use of intellectual-coloured games (ICG) helping to divert the child's attention and allows the operator to work more efficiently.[10] ICG has shown to enhance patient compliance and divert patient's attentiveness. These observations are in accordance with the study conducted by Debs NN et al in 2017, which showed that a child's participation in intellectual games increases endorphin release thereby boosting his or her confidence & modulates their mood and behavior.[10]

The present study aimed to compare and evaluate the effectiveness of virtual reality eyeglasses vs intellectual colored game as a distraction aid to reduce anxiety of children undergoing dental procedure.

2. Materials and Methods

2.1. Study design

The study was an in vivo interventional comparative study. A total sample of 90 children was selected randomly aged between 4-7 years. Comprehensive medical and dental history along with informed consent was taken from the parents. The study was carried out during the OPD timings in the Department of Pediatric and Preventive Dentistry, Sudha Rustagi College of Dental Sciences and Research, Faridabad. The study protocol was approved by the institutional ethical committee (Ref no: SRCDSR/ACAD/2022/10829)

2.2. Sample determination

Sample size estimation was done by using GPower software (version 3.0). Sample size was estimated for F test and ANOVA: Repeated measures, between factors, for 3 groups & 3 follow up measurements, was chosen. A minimum total sample size of 90 was found to be sufficient for an alpha of 0.05, power of 80%, 0.275 as effect size.

2.3. Inclusion criteria

Children with Modified Frankl's behavior 2, 3 and 4

Children free from any systemic diseases

Children without any anxiety disorders and who required restorative dental procedure, were included in the study.

2.4. Exclusion criteria

Medically compromised children.

Specially abled children.

Patient who had past dental visit history, and Modified Frankl behavior rating 1 and 5.

2.5. Methods

The sample comprised of ninety children who were randomly divided by the co-investigator into three groups with 30 children in each group.

The three groups were as follows:

Group I (Control Group): The dental restorative procedure was done without any distraction.

Group II (VR Group): The dental restorative procedure was performed with audio-visual distraction through VR headset (Samsung Gear VR).

Group III (ICG Group): The dental restorative procedure was performed with visual distraction through intellectual colored game.

Children in all the subgroups went through two dental visits. During the first visit, for all the groups, children fulfilling the inclusion criteria were selected and baseline anxiety scores were recorded. The treatment consisted of 2 consecutive visits. All dental restorations were carried out by one principal investigator and the anxiety scales were recorded by an outcome assessor who were not a part of the study but were calibrated to take the readings.

In second visit dental restorative procedure was performed without any distraction.

During the first visit for group II (VR Group), along with oral examination, with the help of tell-show-do technique children were introduced to VR Headset. At the time of second visit for group II, all children got some time to get familiar with the VR device. The device was connected to mobile device (Samsung M30) in which the child was shown cartoon video clips of his/her choice. Once the headset was secured on the child's eyes, dental restorative procedure was performed.

In second visit for group III, the child was shown the intellectual-colored game which was kept in front of the child by securing it in the dental chair and the child was asked to identify the different shapes and colors on the game board during the restorative procedure.

2.6. Evaluation of anxiety

Combination of four measures were used to assess child's dental anxiety:

Physiological parameter: With the help of a fingertip pulse oximeter, oxygen saturation & pulse rate were recorded.

2.7. Behavioral measures

Subjective Assessment was done using Venham's anxiety rating scale which is a six-pointer scale and is used to assess the situational anxiety of the child by the pediatric dentist.

Objective Assessment was done using Facial Image Scale. It consists of a row of five faces which are from very happy to very unhappy. The child is asked to point at the face he/she relates with most at that moment. A value of 1 is given for the most positive face and 5 for the most negative face. Faces four and five indicate high dental anxiety.

2.8. Statistical analysis

Data was analysed using Statistical Package for Social Sciences (SPSS) version 21, IBM Inc. Descriptive data was reported for each variable. Summarized data was presented using Tables and Graphs. Data was not normally distributed as tested using Shapiro wilk test (p<0.05): Modified Frankl's Behaviour Rating Scale, Venham's Anxiety Rating Scale, Facial Image Scale. Hence, non-parametric test and Kruskal Wallis was used for comparison of two or more groups. Pair wise comparison was done using Mann Whitney U Test for two independent groups and pair wise comparison was done suing Wilcoxon paired T test for paired data. For pulse rate and oxygen saturation, parametric test were used. A level of p<0.05 was considered statistically significant.

3. Results

This study was an in vivo interventional comparative study wherein the outcome assessor and statistician were blinded. The sample size comprised of 90 children who were divided into three different groups by the co-investigator with 30 children in each group. The following results were obtained which are described below.

A comparison of Modified Frankl's Behavior Rating among three groups is shown in Table 1. The ICG group, during second visit showed a mean value of 2.500 compared to Control group with mean scores of 3.600 post treatment which showed a statistically significant reduction in anxiety with ICG Group.

Table 2 shows a comparison of Venham's Anxiety Rating Scale at different intervals among three groups. During second visit, results showed significant reduction in anxiety with VR & ICG Group when compared to Control group. (p<0.001)

Fig. 1: Samsung Gear VR Headset

Fig. 2: Intellectual coloured game

Fig. 3: Dental restorative procedure done without any distraction (Control group)

Table 1: Shows comparison of modified frankl's behavior among three groups: at three intervals of time: baseline, pre-op and post-op

		N	Mean	Std. Deviation	chi square value	p^a value	p^b value
	Group I	30	3.800	.9965	0.596	0.742, ns	NA
Baseline	Group II	30	3.667	1.0933			
	Group III	30	3.867	1.0743			
	Group I	30	3.600	1.0034			
Pre-op	Group II	30	3.133	1.0743	4.818	0.090, ns	NA
	Group III	30	3.033	.8899			
	Group I	30	3.600	1.0034			I & II: 0.645, ns
Post-op	Group II	30	3.067	1.0807	6.200	0.045*, sig	I & III,0.020*, sig
	Group III	30	2.500	1.1963			II & III: 0.064, ns

Table 2: Shows comparison of venham's anxiety rating scale among three groups: at three intervals of time: baseline, pre-op and post-op

		N	Mean	Std. Deviation	chi square value	p^a value	p^b value
	Group I	30	1.33	.844	3.901	0.142, ns	NA
Baseline	Group II	30	1.57	.898			
	Group III	30	1.10	.885			
	Group I	30	1.32	.671			I & II: 0.002*, sig
Pre-op	Group II	30	1.7	0.9154	18.266	0.001*, sig	I & III,0.001*, sig
	Group III	30	1.433	0.8584			II & III: 0.300, ns
	Group I	30	1.32	.671			I & II: 0.064, ns
Post-op	Group II	30	1.233	1.0726	16.798	0.001*, sig	I & III,0.001*, sig
	Group III	30	0.7	0.7022			II & III: 0.37, NS

Table 3: Shows Comparison of Facial Image Scale among three groups: at three intervals of time: baseline, pre-op and post-op

		N	Mean	Std. Deviation	chi square value	p^a value	p^b value
	Group I	30	3.333	.8442	1.419	0.492, ns	NA
Baseline	Group II	30	3.400	1.0034			
	Group III	30	3.600	1.0034			
	Group I	30	3.133	0.9143			
Pre-op	Group II	30	3.300	.7944	1.677	0.311, ns	NA
	Group III	30	3.100	1.0619			
	Group I	30	3.133	0.9143			I & II: 0.844, ns
Post-op	Group II	30	3	0.871	8.513	0.014*, sig	I & III: 0.012*, sig
	Group III	30	2.966	.9814			II & III: 0.012*, sig

Table 4: Shows Comparison of pulse rate among three groups: at three intervals of time: baseline, pre-op and post-op

		N	Mean	Std. Deviation	f value	p^a value	p^b value
	Group I	30	104.9333	10.157	2.126	0.125, ns	NA
Baseline	Group II	30	101.3000	5.147			
	Group III	30	101.3333	7.410			
	Group I	30	103.98	9.1827			I & II: 0.001*, sig
Pre-op	Group II	30	97.1667	5.427	1.984	0.001*, sig	I & III, 0.001*, sig
	Group III	30	94.9000	6.650			II & III: 0.001*, sig
	Group I	30	102.98	8.421			I & II: 0.988, ns
Post-op	Group II	30	96.2000	7.29856	18.237	0.001*, sig	I & III, 0.001*, sig
	Group III	30	87.0000	7.40922			II & III: 0.001*, sig

Table 5: Shows Comparison of oxygen saturation among three groups: at three intervals of time: baseline, pre-op and post-op

		N	Mean	Std. Deviation	f value	p^a value	p^b value
Baseline	Group I	30	94.4333	2.45909			NA
	Group II	30	95.4667	2.37419	3.055	0.052, ns	
	Group III	30	95.8621	2.03055			
Pre-op	Group I	30	94.4667	2.44573			NA
	Group II	30	95.5000	2.14556	2.757	0.069, ns	
	Group III	30	95.8276	2.39149			
Post-op	Group I	30	95.1667	2.71755			I & II: 0.141, ns
	Group II	30	96.3667	1.67091	4.787	00.001*, sig	I & III, 0.008*, sig
	Group III	30	97.1034	2.75609			II & III: 0.478, ns

Fig. 4: Dental restorative procedure done with Audio-visual distraction (Virtual reality group)

Fig. 5: Dental restorative procedure done with mental distraction (ICG Group)

Table 3 shows a comparison of Facial Image Scale among three groups at three intervals of time. It showed that during the second visit, the mean value of ICG Group post treatment was 2.966 and for Control group it was 3.133 with a significant p value of 0.012.

Table 4 shows a comparison of pulse rate of study participants at different time intervals. A significant decrease in pulse rate is observed with ICG Group from baseline to during treatment and post treatment when compared to Control & VR Group which was statistically significant. (p<0.001)

When oxygen saturation was analyzed, significant increase from baseline to post treatment was seen with ICG Group compared to Control Group and VR Group as shown in Table 5.

4. Discussion

According to Folyan MO et al. (2004), dental anxiety can be termed as a sense of uneasiness and anxiety about the dental procedure which might not essentially be related to a specific external stimulus.[11] Various methods to reduce anxiety and manage apprehensive child have been introduced which facilitates better performance of treatment. Bellieni CV et al., in his study observed that visual and audio stimulation have proved to divert the attention of patient by introducing him to 2-D or 3-D animations.[12]

In the present study, two different approaches were used to distract the patient during a dental restorative procedure at three intervals of time. A significant reduction in anxiety when assessed through behavior rating scale and anxiety rating scales from first to second visit in VR and ICG Group was observed. The results are in accordance with the research carried out by Tailor B et al.,[13] Shetty et al.,[14] Chaturvedi et al.,[15] Asl Aminabadi et al.,[16] It was observed that this technique was found to be efficacious in modifying dental pain and anxiety. It lets the child get detached from the dental operatory environment and immerse in a playful and relaxed virtual space.[17]

Mental distraction, a novel behaviour management strategy utilizes environmental elements such as colors and shapes to produce positive feelings in a child that reduces anxiety and fear. In the present study, it has been observed that intellectual distraction can also be used in anxious children as a behaviour modification technique to allay anxiety. The results of our study are in accordance with the study conducted by Debs NN et al. wherein intellectual distraction allowed them to take a better alginate impression

and reduced gag reflex by gaining the child's focus and thereby increasing his compliance.[10] Hence, it makes the present study unique as this method has not been been attempted in the past.

Buchanan's FIS, a reliable and valid indicator of anxiety is used in the present study to assess anxiety state in anxious child.[18] This is in accordance with study conducted by Newton JT et al.,[19] Pulse oximeter was used to measures the pulse rate and oxygen saturation. It is one of the most acceptable methods for measuring the physiological change.[20] In the present study, observations from the results show that there was a significant decrease in pulse rate in VR & ICG Group when compared to the control group.

In conclusion, findings of the present study states that both the techniques i.e., AVD using VR Eyeglasses and Mental distraction using Intellectual coloured game, gave comparable results. Furthermore, due to some limitations of audio-visual distraction using VR headset, Intellectual distraction has proven to be a promising distraction aid during dental procedure to allay anxiety and fear in children.

5. Limitations

There were some restrictions associated with the audio-visual distraction technique used in the present study. Communication between the dentist and the patient might get hindered by the sound of video clip playing in the VR headset and it can prevent the clinician to establish a proper relationship with the patient, hence the volume should be kept at a minimum level. Also, sometimes when the child is apprehensive and fearful, he hesitates to accept this approach due to complete block-out from the real world by hindering the audio-visual stimuli. Due to certain limitations of this approach, Intellectual Distraction has proven to be more efficient and beneficial in anxious children.

6. Source of Funding

None.

7. Conflict of Interest

None.

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