

Assessment of Efficacy of Virtual Reality Distraction in Reducing Pain Perception and Anxiety in Children Aged 6–10 Years: A Behavioral Interventional Study

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ABSTRACT

Aim: The aim of the present study was to assess the effectiveness of virtual reality distraction on pain perception and state anxiety levels undergoing restorative treatment in children.

Materials and methods: This was an interventional study with 30 children of age 6–10 years came to the Department of Pedodontics and Preventive Dentistry. The intervention was distraction with virtual reality eyeglasses and the parameters considered includes pain perception analyzed subjectively by Wong Baker FACES pain rating scale and objectively by FLACC scale; anxiety was analyzed physiologically by measuring pulse rate and oxygen saturation levels using pulse oximeter. The parameters were recorded before the treatment, i.e., baseline, during and as well as after the restorative treatment procedure. The values noted were tabulated and subjected to appropriate statistical analysis with *p* value set at 0.05.

Results: The study displayed a very high statistical significance in reduction of pain perception and anxiety levels in all the comparisons made at three time periods, i.e., baseline, during and after treatment procedure (*p* < 0.0001).

Conclusion: Virtual reality distraction can be considered as a budding distraction tool in the arena of behavior management that helps adapt the child to dental environment and able to deliver qualitative dental care.

Clinical significance: Managing an anxious child is one of the challenging tasks for a pediatric dentist in the day-to-day life. As the world progresses with newer interventions, virtual reality distraction is one among them that has the ability to reduce pain perception and anxiety in children with a positive approach.

Keywords: Behavior, Children, Dental anxiety, Interventional study, Pain, Virtual reality eyeglasses.

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INTRODUCTION

The term pain and anxiety are the most annoying feelings and emotional experiences, that are associated with real or possible traumas to tissues.¹ Pain is a subjective one and its perception depends on several factors like physiological, psychological, social, culture and to some extent on genetics. The perception of pain increases when the child is consciously attentive in that particular environment and is also related to the appalling thinking about pain, anxiety and fear associated with it, respectively.²

Both pain perception and dental anxiety in children leads to the avoidance of dental treatment which in turn results in deterioration of oral health, leading to more problem-oriented visiting, which serves to maintain or exacerbate the person's level of dental anxiety.¹ In children, if treatment was given without alleviation of anxiety, not only hampers the quality of dental care, it also creates a undesirable impact of their judgment on dentistry in future. Henceforth, it is of great importance that the dental health professionals should be able to detect the children with dental anxiety and apply appropriate behavior management techniques at the earliest age possible.^{3,4}

Management strategies have been projected to minimize pain and discomfort during dental treatment in children. They are mainly divided into two broad categories. The first module consists of nonpharmacological behavioral techniques like the tell-show-do technique, distraction, modeling and hypnotism. The second category consists of pharmacologic techniques.^{5,6} Distraction is

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the technique of diverting the children attention from what may be professed as an unpleasant procedure and was one of the most commonly used and effective behavior guidance technique. The newer method of distraction that is gaining popularity in the present is virtual reality distraction (VRD).

Virtual reality (VR) refers to “a human–computer interface that allows the user to interact dynamically with the virtual world, which is essentially a computer-generated environment.” The application of virtual reality as a distraction technique could perhaps be superior to traditional distraction techniques because “it offers more immersive images via the occlusive headsets that project

the images right in front of the eyes of the user.” Depending on the model of VR device used, it may block out the real-world by hindering the visual, auditory, or both the stimuli.⁷

So, the aim of present study was to assess the pain perception and anxiety of children by using virtual reality distraction. The hypothesis will be null hypothesis, i.e., neither or nor virtual reality distraction is related to anxiety and pain perception.

MATERIALS AND METHODS

Source of the Data

After obtaining Institutional Ethical Clearance as per the code of ethics of the World Medical Association and declaration of Helsinki, parents’ consent form, children aged 6–10 years were selected based on the inclusion criteria from the OPD of Department of Pedodontics and Preventive Dentistry, AME’s Dental College and Hospital, Raichur, Karnataka from September 2018 to October 2018.

Study Design

The present study was an interventional clinical study with parallel design and virtual reality distraction being the intervention.

Sample Size Determination

Based on the previous pilot study, taking 80% power and 5% margin of error (1 – β) and a total of 30 children were considered as appropriate sample size to fulfill the purpose of the study.

Methods

Children with Frankl’s behavior 3 and 4, who are free from any psychological as well as systemic illness, without any anxiety disorders and with a requisite for restorative dental procedure, were included in the study. The parameters assessed were pain perception and anxiety before, during and after the procedure. Pain was measured in two ways by using self-reported Wong Baker faces pain scale (WBFPS) and objectively by FLACC scale. Anxiety was assessed physiologically by using pulse oximeter (Nellcor COVIDIEN SPO₂ sensor compatible planet 50n LT model) in which pulse rate and oxygen saturation was monitored. Virtual reality distraction (VRD) eyeglasses (ANTVR Phone Glass T2, Model PA15LF53A) with a choice of three cartoons that is left for their choice was given to the child before the start of the restorative procedure and they were removed only after the completion of the procedure, if any inconvenience was encountered by the child during the procedure

they were advised to inform by using signalling system. Prior to the start of the procedure the child was made adaptive by elucidation about the eyeglasses. One examiner who was accustomed with the scales recorded all the parameters. The data was analyzed using SPSS version 21.0 and subjected to statistical analysis.

Statistical Analysis

Descriptive and inferential statistics were applied wherever required. The results were expressed in mean and standard deviation, Wilcoxon signed rank test and paired “t” test was used in the present study to evaluate the parameters accordingly. The statistical significance was set at 0.05.

RESULTS

Demographic Data

Among 30 children recruited into the study, 18 (60%) were boys and 12 (40%) were girls. The mean age of the children was 7.77 ± 1.88 (Table 1).

Pain Perception

Subjective Assessment of Pain

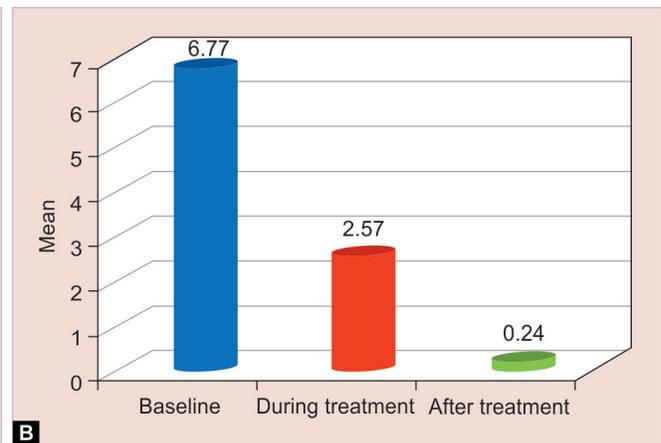
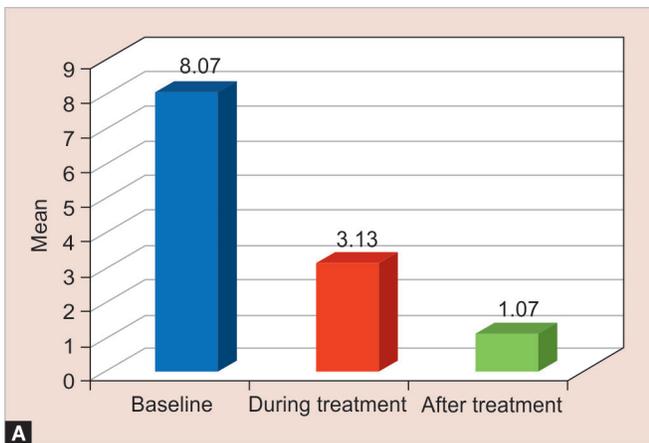
Pain perception that was rated by Wong Baker FACES pain rating scale was compared at baseline, during and after restorative procedure, very high statistical significance was found (*p* < 0.0001) (Fig. 1). The mean scores were 8.07 ± 2.20 and 3.13 ± 1.25 when baseline to during treatment was compared and to baseline and after treatment, mean score is 8.07 ± 2.20 and 1.07 ± 1.26, respectively. The mean scores during treatment and after treatment were 3.13 ± 1.25 and 1.07 ± 1.26, respectively. This assessment stipulates that pain perception in children was reduced by using visual reality distraction.

Objective Assessment of Pain

When pain was assessed objectively, the mean score of children from baseline to during treatment is 6.77 ± 1.79 and 2.57 ± 1.01; from baseline to after treatment it is 6.77 ± 1.79 and 0.24 ± 0.74,

Table 1: Demographic data

Boys	18 (60%)
Girls	12 (40%)



Figs 1A and B: Assessment of pain perception scores rated by (A) Wong Baker FACES pain rating scale; (B) FLACC scale

respectively, during treatment and after treatment it is 2.57 ± 1.01 and 0.24 ± 0.74 , respectively (Table 2). Comparisons between them was found to be very high statistically significant ($p < 0.0001$) (Fig. 1).

Anxiety

Assessment of Pulse Rate

On comparing pulse rate of study participants at different time intervals there is a gradual decrease in pulse rate observed from baseline to during treatment and after treatment which was highly statistical significance ($p < 0.0001$), mean scores being 104.97 ± 9.74 and 93.53 ± 8.60 , respectively (Fig. 2). Pulse rate when compared during and after treatment was increased that was high statistically significant, mean score is 93.53 ± 8.60 and 95.97 ± 7.62 ($p < 0.001$) (Table 3).

Assessment of Oxygen Saturation

When oxygen saturation was analyzed, there was an increase from baseline to during treatment and after treatment with the high statistical significance ($p < 0.0001^*$) (Fig. 2). The levels when

compared during and after treatment, the mean scores were almost same, i.e., 99.8 ± 0.41 and 99.87 ± 0.35 , respectively but they are statistically insignificant ($p = 0.161$) (Table 3).

DISCUSSION

As the anxiety was the most common problem encountered in the pediatric dentistry, that illustrates its effects on the child, parent as well as the dentist in coping and rendering qualitative dental treatment. The present study was carried out mainly to assess the pain perception and anxiety while the VRD was applied. The validity and reliability of the scales (WBFPS and FLACC) used in the present study was previously evaluated by many studies.⁸⁻¹⁰

The result of the present study was in accordance to Shetty et al.,¹¹ Chaturvedi et al.,¹² Asl Aminabadi et al.,⁸ Wiederhold et al.¹³ and Sullivan et al.,¹⁴ where both the pain perception and anxiety were reduced. As both the pain perception and anxiety increase if the child focusses on the procedure or sight of instruments in dentistry; the child was taken into a different environment by applying VRD which is devoid of the operator's field and its sounds.

Table 2: Comparison of Wong Baker FACES pain rating scale and FLACC scale

	N	Mean ± (SD)	Wilcoxon signed rank test p value
<i>Wong-Baker FACES pain rating scale</i>			
Baseline	30	8.07 ± 2.20	0.0001*
During treatment	30	3.13 ± 1.25	
Baseline	30	8.07 ± 2.20	0.0001*
After treatment	30	1.07 ± 1.26	
During treatment	30	3.13 ± 1.25	0.0001*
After treatment	30	1.07 ± 1.26	
<i>FLACC scale score</i>			
Baseline	30	6.77 ± 1.79	0.0001*
During treatment	30	2.57 ± 1.01	
Baseline	30	6.77 ± 1.79	0.0001*
After treatment	30	0.24 ± 0.74	
During treatment	30	2.57 ± 1.01	0.0001*
After treatment	30	0.24 ± 0.74	

*Very high statistical significance. N, number; SD, standard deviation

Table 3: Comparison of pulse rate and oxygen saturation levels

	N	Mean ± SD	Paired t test p value
<i>Pulse rate</i>			
Baseline	30	104.97 ± 9.74	0.0001*
During treatment	30	93.53 ± 8.60	
Baseline	30	104.97 ± 9.74	0.0001*
After treatment	30	95.97 ± 7.62	
During treatment	30	93.53 ± 8.60	0.001**
After treatment	30	95.97 ± 7.62	
<i>Oxygen saturation level</i>			
Baseline	30	98.2 ± 0.71	0.001**
During treatment	30	99.8 ± 0.41	
Baseline	30	98.2 ± 0.70	0.001**
After treatment	30	99.87 ± 0.35	
During treatment	30	99.8 ± 0.41	0.161
After treatment	30	99.87 ± 0.35	

*Very high statistical significance; **High statistical significance. N, number; SD, standard deviation

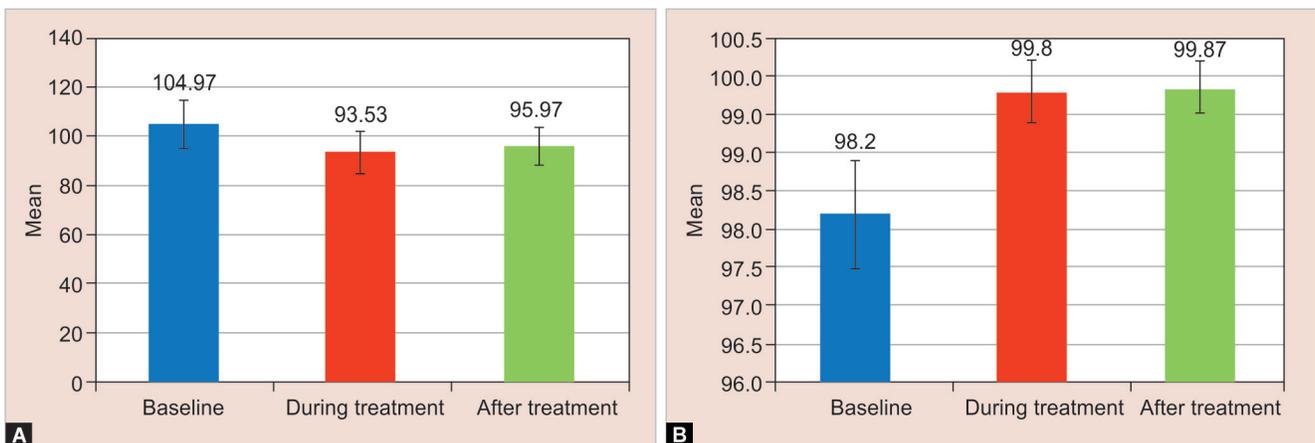


Fig. 2: Assessment of anxiety through (A) Pulse rate; (B) Oxygen saturation



The effect of VRD can be carried after the treatment; this can be explained by comparing the oxygen saturation levels during and after the treatment but it was not found to be statistically significant. In addition, pulse rate during the procedure was illustrated to be less, which agrees that the child was in relaxed state during the procedure which is advantageous to the pediatric dentist.

The working principle of VRD is that it does not interrupt the pain signals but acts both directly and indirectly on pain perception and signalling.¹⁵ Several studies have evaluated the efficacy of VRD in the fields of medicine and dentistry and showed virtuous results. A study by Hoffman et al., compared VRD with opioids and found that virtual reality and opioid analgesics had same equivalent results in terms of pain reduction, and it was found that the combination of opioids with virtual reality ensued in significant reduction in pain signals.¹⁶ Therefore, VRD has the potential to reduce pain perception.

Furthermore, the other advantages of VRD include its ease of usage, more acceptance, safety, economic less complexity in understanding the procedure whereas the disadvantage of VRD is communication with the child when it is in use.^{8,17}

In addition to this, VRD has the potential to reduce the memories during the procedure.¹⁸ So any unpleasant stimulus during the procedure does not have any effect on the future appointment. Furthermore, VRD helps to instill a positive attitude towards the dentist and dental treatments that can be carried out through adolescence into adulthood.

According to recent systematic reviews, evidence is very low that states distraction techniques to be effective in reducing fear and anxiety during dental treatment which signifies further interventional studies should be conducted.¹⁹ Furthermore, the limitations of the present study include, it would be better if different treatment procedures were evaluated separately, if both the genders are recruited equally and trait anxiety was not evaluated. One of the interesting features of VRD is that its effect on behavior modification can be carried for long-term.¹⁸ So, it throws a challenge for researchers for further long-term follow-up studies based on VRD.

CONCLUSION

VRD that utilizes the new VR can be considered as an effective means of behavior guidance technique that reduces the anxiety and pain perception in children.

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