



## Original Research Article

## Effectiveness of virtual reality eyeglasses as a distraction technique in managing anxious paediatric patients undergoing dental treatment- A cross-sectional study

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## ABSTRACT

**Aim:** To evaluate the effect of virtual reality eyeglasses as a distraction technique in management of anxious paediatric patients undergoing dental treatment.

**Materials and Methods:** It is an in-vivo study which was performed on 148 patients with 37 in each four different groups. Children's dental anxiety was measured using Modified Dental Anxiety Scale (MDAS) and Pulse oximeter which measures the pulse rate, oxygen saturation. After assessing the anxiety levels of the children, children who are found to be anxious were taken for the study.

**Group A** includes children who have to undergo extraction without virtual reality eyeglasses.

**Group B** includes children who have to undergo extraction with virtual reality eyeglasses.

**Group C** includes children who have to undergo restoration without virtual reality eye glasses.

**Group D** includes children who have to undergo restoration with virtual reality eye glasses. Children's anxiety was again evaluated using the Modified Dental Anxiety Scale (MDAS) and Pulse oximeter during dental treatment. The results obtained were then compared.

**Results:** The data was collected, tabulated, Descriptive statistics and paired t test was used for statistical analysis.

Group A: There were statistically significant changes in pulse rate, oxygen saturation (SPO<sub>2</sub>) and modified anxiety scale (p<0.05). Group B: There were statistically significant changes in pulse rate and modified anxiety scale (p<0.05), but there were no statistically significant changes in the oxygen saturation (SPO<sub>2</sub>) level (p>0.05). Group C: There were statistically significant changes in pulse rate and modified anxiety scale (p<0.05), but there were no statistically significant changes in the oxygen saturation (SPO<sub>2</sub>) level (p>0.05). Group D: There were statistically significant changes in pulse rate and modified anxiety scale (p<0.05), but there were no statistically significant changes in the oxygen saturation (SPO<sub>2</sub>) level (p>0.05)

**Conclusion:** Within the limitations of this study we conclude that virtual reality eyeglasses used in the present study is an effective distraction technique in management of pediatric patients undergoing dental treatment.

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### 1. Introduction

Managing paediatric patients in dental clinic is the greatest challenge that a dentist is facing today. Dental anxiety and phobia result in avoidance of dental care. Children reporting

to the dental clinic are found to be anxious as they consider the dental clinic to be an undesirable place to visit. False information from the peer groups, social media and even indirectly from the parents have created an objective fear and anxiety within many children.<sup>1</sup>

Dental anxiety is a state of apprehension that something dreadful is going to happen in relation to dental treatment

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and it is coupled with a sense of losing control.<sup>2</sup> The general perception of dental anxiety is that it can lead to avoidance which results in lack of dental care and delay in finding suitable treatment.<sup>3,4</sup>

Managing the behaviour and anxiety of a child by rendering additional positive experience is the primary objective of pediatric dentist and to perceive this various behaviour management techniques are used.<sup>5</sup> These techniques are divided into two broad categories.

1. First category consist of behavioural techniques including the tell show do (TSD), inspiration, modelling, distraction and hypnotism.
2. The second category consists of pharmacological methods such as conscious sedation and general anaesthesia.

Among these, the distraction technique appears to be safe and cost effective.<sup>6</sup>

Distraction technique is a method of diverting a child's attention from perceiving an unpleasant procedure. It is the most common technique used to reduce pain in short invasive dental procedures. The principle behind its effectiveness is to hinder the ability to pay attention to unpleasant stimuli during the dental procedures and switching the child's focus to mesmerizing distracters. Distraction can be of two forms; that is active or passive. Active distraction promotes a child's participation including various sensory components such as interactive toys, virtual reality eyeglasses, controlled breathing, and relaxation. Passive distraction includes listening to music and watching television.<sup>5</sup>

Virtual Reality refers to a human-computer interface that allows the user to interlink effectively with the computer generated environment. This technique is superior to previous distraction methods as it offers a better immersive images that shows the images in front of our eyes. It combines the audio, video and kinesthetic sensory modalities. Depending upon how captivating the presenting stimulus are, the person's concentration will be more or less 'drained' from the actual world, thus reducing the attention from the real world procedure, which includes painful stimulus. Immersion is more during virtual reality (VR) because of the use of head mounted, wide field of view, three dimensional displays (HMD's) that restricts the children from seeing the things happening in the real world and manage the focus on what's going in the virtual world. So the child's concentration is deviated from the surrounding world to the virtual world.<sup>7</sup> The aim of the study is to evaluate the effect of virtual reality eyeglasses as a distraction technique in managing anxious pediatric patients undergoing dental treatment such as restoration and extraction.

## 2. Materials and Methods

A total of 148 subjects with 37 each in four groups, were selected from the OPD in the Department of Pediatric and preventive dentistry, Yenepoya Dental College, in the age ranging between 7-14 years. All subjects were healthy individuals free of medical comorbidities, post traumatic stress disorder and anxiety disorders. This study was conducted after obtaining the institutional ethics committee clearance and informed written consent from the subjects or parents of the selected subject.

Parents were given a brief introduction explaining the procedure and purpose of the study.

Children's dental anxiety was measured using Modified Dental Anxiety Scale and Pulse oximeter. The pulse rate and oxygen saturation (SPO<sub>2</sub>) was measured.

After assessing the anxiety levels of the children, children who were found to be anxious were taken for the study.



**Fig. 1:** Virtual reality eyeglasses

Patients were then seated for appropriate dental treatment.

**Group A:** included children who had to undergo extraction without virtual reality eyeglasses.

**Group B:** included children who had to undergo restoration without virtual reality eyeglasses.

**Group C:** included children who had to undergo extraction with virtual reality eye glasses.

**Group D:** included children who had to undergo restoration with virtual reality eye glasses.

Children's anxiety was again evaluated using the Modified Dental Anxiety Scale and Pulse oximeter after dental treatment. The results obtained were then compared.

### 2.1. Statistical analysis

The data was collected, tabulated, and statistically analyzed using the paired t-test (IBM SPSS Statistics Version 23, IBM Corporation, New York, USA). Descriptive statistics and paired t-test were used at a significance level of P less



**Fig. 2:** Patient undergoing extraction with virtual reality eyeglasses

than or equal to 0.05.

### 3. Result

There were statistically significant changes in pulse rate, oxygen saturation (SPO<sub>2</sub>) and modified anxiety scale (p<0.05).

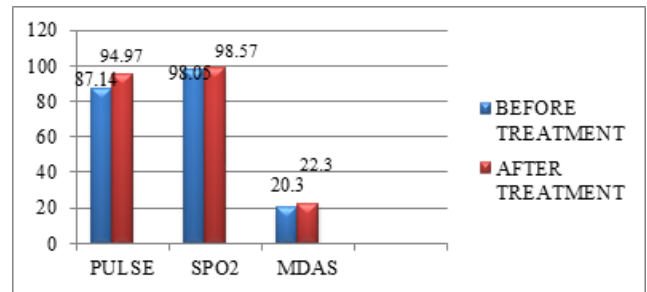
There were statistically significant changes in pulse rate and modified anxiety scale (p<0.05), but there were no statistically significant changes in the oxygen saturation (SPO<sub>2</sub>) level (p>0.05).

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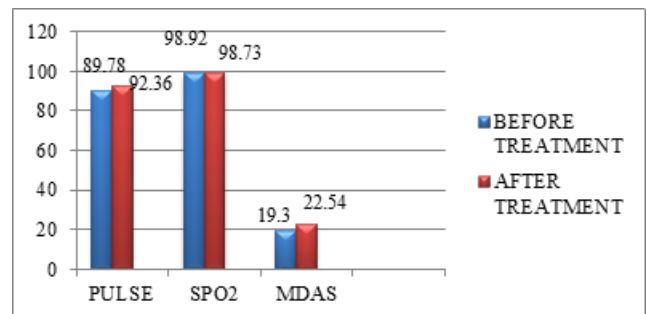
There were statistically significant changes in pulse rate and modified anxiety scale (p<0.05), but there were no statistically significant changes in the oxygen saturation (SPO<sub>2</sub>) level (p>0.05).

### 4. Discussion

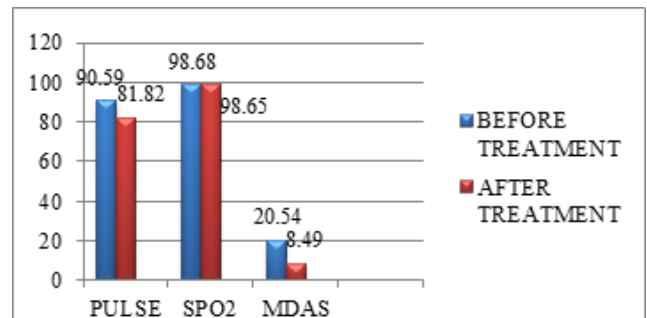
Dental anxiety in children has become as a recognized potential behavioral management problem with a prevalence of 3 to 43% in various population.<sup>3,4</sup> Managing the behaviour and anxiety of an anxious child to become a cooperative patient is critical for the success of dental treatment.<sup>7</sup> Diminishing a child's anxiety about the dental treatment procedure is therefore an important in reducing



**Fig. 3:** Mean value of pulse rate, oxygen saturation (spO<sub>2</sub>), modified dental anxiety scale score (MDAS) of group A (extraction without virtual reality eyeglasses)



**Fig. 4:** Mean value of pulse rate, oxygen saturation (spO<sub>2</sub>), modified dental anxiety scale score (MDAS) of group B (restoration without virtual reality eye glasses)



**Fig. 5:** Mean value of pulse rate, oxygen saturation (spO<sub>2</sub>), modified dental anxiety scale score (MDAS) of group C (extraction with virtual reality eye glasses)

apprehension that may later continue into adulthood.<sup>8</sup> Although traditional techniques may be successful, the attitude of parents and dental professionals towards the technique is changing.<sup>7</sup> Virtual Reality (VR) eyeglasses is a promising effective distraction technique for reducing the pain during painful dental procedures.<sup>9-12</sup>

The age group of the patients selected in the present study belonged to 7-10 years as children show disruptive or negative behaviour in this age group and are difficult to manage.<sup>12</sup> The pulse oximeter works by placing a sensor device on the extremities or a thin part of the

**Table 1:** Extraction without virtual reality eyeglasses (Group A)

		Mean	N	Std. Deviation	Std. Error Mean
Pulse Rate	Before	87.14	37	5.731	0.942
	After	94.97	37	4.592	0.755
SPO2	Before	98.05	37	1.053	0.173
	After	98.57	37	1.168	0.192
Modified Dental Anxiety Score	Before	20.30	37	1.824	0.300
	After	22.30	37	2.120	0.348

**Table 2:** Shows the group in which the extraction was being carried out without using virtual eyeglasses

	Mean	Std. Deviation	Paired Differences		Sig. (2-tailed)
			95% Confidence Interval of the Difference		
			Lower	Upper	
Pulse rate Before-after	-7.838	3.617	-9.044	-6.632	0.000
SPO <sub>2</sub> Before - After	-0.514	0.804	-0.781	-0.246	0.000
Modified Dental Anxiety Before-after	-2.000	2.173	-2.725	-1.275	0.000

**Table 3:** Restoration without virtual reality eyeglasses (Group B)

		Mean	N	Std. Deviation	Std. Error Mean
Pulse Rate	Before	89.78	37	6.281	1.033
	After	92.38	37	6.339	1.042
SPO2	before	98.92	37	0.894	0.147
	after	98.73	37	1.851	0.304
Modified Dental Anxiety Score	before	19.30	37	1.266	0.208
	after	22.54	37	1.726	0.284

**Table 4:** Shows group in which the restoration was being carried out without using virtual eyeglasses

	Mean	Std. Deviation	Paired Differences		Sig. (2-tailed)
			95% Confidence Interval of the Difference		
			Lower	Upper	
Pulse Rate Before-After	-2.595	1.624	-3.136	-2.053	0.000
SPO <sub>2</sub> Before-After	0.189	1.838	-0.424	0.802	0.535
Modified Dental Anxiety Before-After	-3.243	1.832	-3.854	-2.632	0.000

**Table 5:** Extraction with virtual reality eyeglasses (Group C)

		Mean	N	Std. Deviation	Std. Error Mean
Pulse Rate	Before	90.59	37	5.956	0.979
	After	81.92	37	5.030	0.827
SPO2	Before	98.68	37	1.203	0.198
	After	98.65	37	1.230	0.202
Modified dental anxiety score	Before	20.54	37	1.909	0.314
	After	8.49	37	2.281	0.375

**Table 6:** Shows group in which the extraction was being carried out using virtual eyeglasses

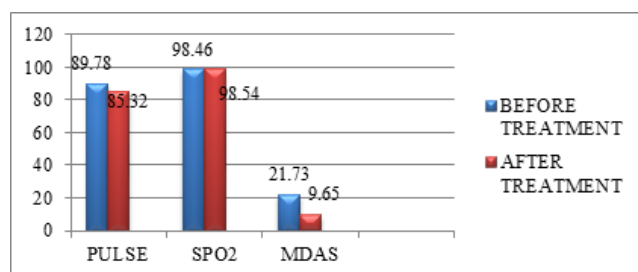
	Mean	Std. Deviation	Paired Differences		Sig. (2-tailed)
			95% Confidence Interval of the Difference		
			Lower	Upper	
Pulse rate Before-after	8.676	3.909	7.372	9.979	0.000
SPO <sub>2</sub> Before -After	0.027	0.499	-0.139	0.193	0.744
Modified dental anxiety Before -after	12.054	2.483	11.226	12.882	0.000

**Table 7:** Restoration with virtual reality eyeglasses (Group D)

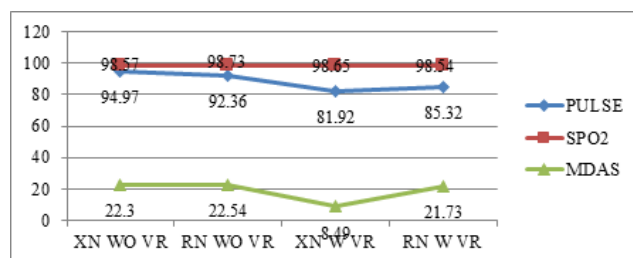
		Mean	N	Std. Deviation	Std. Error Mean
Pulse Rate	Before	89.78	37	6.083	1.000
	After	85.32	37	6.896	1.134
SPO2	Before	98.46	37	1.238	0.204
	After	98.54	37	1.169	0.192
Modified Dental Anxiety Score	Before	21.73	37	2.009	0.330
	After	9.65	37	2.781	0.457

**Table 8:** Shows group in which the restoration was being carried out using virtual eyeglasses

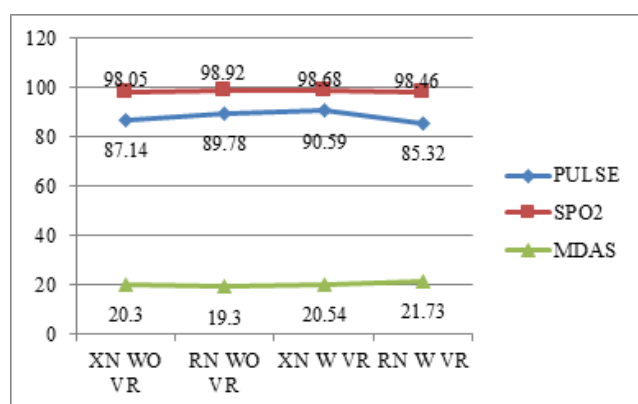
	Mean	Std. Deviation	Paired Differences		Sig. (2-tailed)
			95% Confidence Interval of the Difference		
			Lower	Upper	
Pulse rate Before-after	4.459	3.388	3.330	5.589	0.000
SPO <sub>2</sub> Before-After	-0.081	0.682	-0.309	0.146	0.474
Modified dental Anxiety Before-after	12.081	3.639	10.868	13.294	0.000



**Fig. 6:** Mean value of pulse rate, oxygen saturation (sp<sub>o</sub><sub>2</sub>), modified dental anxiety scale score (MDAS) of group D (restoration with virtual reality eye glasses) of group D (restoration with virtual reality eye glasses)



**Fig. 8:** Mean pulse rate, oxygen saturation (sp<sub>o</sub><sub>2</sub>), modified dental anxiety scale (MDAS) score in each group after treatment



**Fig. 7:** Mean pulse rate, oxygen saturation (sp<sub>o</sub><sub>2</sub>), modified dental anxiety scale (MDAS) score in each group before treatment pulse rate, oxygen saturation (sp<sub>o</sub><sub>2</sub>), modified dental anxiety scale (MDAS) score in each group before treatment

patient’s body, usually a finger, toe or earlobe. The device passes two wavelengths of light through the body part to a photodetector.<sup>13</sup> The sensor measures the amount of red and infrared light received by the detector and calculates the amount absorbed. The arterial blood is the only light absorbing component due to its pulsating action over time and gives it an advantage over venous blood and other components of the body which includes bone, tissue, skin, muscle and fat.<sup>13</sup> Momentary stress or anxiety causes the body to breathe a little more shallowly. A shallow breath lowers oxygen levels in the blood, due to which the brain senses as stress. Breathing then becomes a little faster and shallower. Oxygen levels fall a little more.<sup>14</sup>

Many scales have been in use to measure dental anxiety, but many researchers have proved that Modified Dental Anxiety Scale (MDAS) is the most reliable and most acceptable scale to determine dental anxiety because of its high sensitivity and positive and negative predictive values.<sup>14</sup>

The mean pulse rate value in Group A, before extraction without virtual reality eyeglasses was 87.14 + 5.731 and after extraction without virtual reality was 94.97 ± 4.592 which was statistically significant. If the pulse rate value

increases after the dental procedure relatively, it gives an idea that the child is anxious. This suggests pulse rate as an important parameter for assessing anxiety in children. The importance of pulse rate as a physiological parameter of anxiety in children was first reported by McCarthy et al.<sup>15</sup> The mean modified dental anxiety scale value in Group A before extraction was 20.30 + 1.824 and after extraction was 22.30+ 2.120 which was statistically significant. The mean oxygen saturation (SPO<sub>2</sub>) in Group A before extraction was 98.68+ 1.203 and after extraction was 98.65 +1.230 which was statistically significant. This results were similar to the study by Ize-Iyamu IN et al.<sup>13</sup> Whereas in Group C the mean pulse rate value before extraction with virtual reality eyeglasses was 90.59+5.956 and after extraction with virtual reality was 81.92±5.030 which was statistically significant. The mean modified dental anxiety scale value in Group C before extraction was 20.54+ 1.909 and after extraction was 8.49+ 2.281 which was statistically significant and this is in contradictory to the study by Koticha P et al.<sup>16</sup> The observations from our study indicated that the MDAS gave a statistically significant result. The findings showed that the virtual reality eyeglasses which can be used as audiovisual distraction technique have shown a reduction in anxiety. This was in accordance to the results been obtained by Wiederhold et al.<sup>17</sup> and Sullivan et al.<sup>18</sup>

The mean pulse rate value in Group B, before restoration without virtual reality eyeglasses was 89.78+6.281 and after restoration without virtual reality was 92.38±6.339 which was statistically significant. Similar results were obtained by Khokhar et al.<sup>19</sup> The mean modified dental anxiety scale value in Group B before restoration was 19.30+ 1.266 and after extraction was 22.54+1.726 which was statistically significant. The mean oxygen saturation (SPO<sub>2</sub>) in Group B before restoration was 98.92+ .894 and after restoration was 98.73+1.851 which is statistically insignificant. These results were similar to the study by Rayen et al.<sup>20</sup> Whereas in Group D the mean pulse rate value before restoration with virtual reality eyeglasses was 89.78+6.083 and after restoration with virtual reality was 85.32±6.896 was lesser than mean pulse rate value before restoration, which was statistically significant. The mean modified dental anxiety scale value in Group D before restoration was 21.73+ 2.009 and after extraction was 9.65+ 2.781 which was statistically significant.

In the present study, VR eyeglasses showed their effectiveness in respect to pulse rate. These results were in accordance with previous studies conducted by Prabhakar et al. and Hoffman et al. who concluded that the use of audiovisual distraction during dental treatment was more effective in managing anxious children.<sup>21,22</sup> The reason for increased anxiety scores during the cavity preparation and restoration visit maybe due to the sound and sight of the airtor hand piece; a possibility taken into account by

Kleinknecht et al.<sup>23</sup> Anxiety levels also increased during the stressful extraction visit because patient feel more anxious about tooth removal mainly due to the sight of needles than perceiving a pain or feeling helpless.<sup>1,24</sup> Similar results was also observed by Baldwin et al.<sup>25</sup> This result was true in relation to pulse rate; However, no statistically significant difference was seen in relation to oxygen saturation, Clinical signs of anxiety include an increase in the heart rate and hyperventilation.<sup>13</sup> In the present study, no patients with hyperventilation were observed and this can be attributed to the no change in oxygen saturation of the patients before and after procedure. This findings were in accordance by Yelderman et al.<sup>26</sup> and Modified dental anxiety scale which is a reliable tool in measuring dental anxiety concludes virtual reality eyeglasses is an acceptable distraction technique in managing pediatric patient and its similar to the findings observed by Wiederhold et al.<sup>17</sup> The distraction of children by making them watch virtual reality frees all clinicians to concentrate on their work without the need to pacify, reward, or verbally encourage

The use of AVD eyeglasses inspires pleasant memories and positive attitudes toward the dental experience.

## 5. Limitations

The virtual reality eyeglasses method has got certain limitations. Children who demonstrated uncooperative behaviour and refused treatment immediately rejected the virtual reality eyeglasses. Further, virtual reality eyeglasses are not appropriate for children who are highly vigilant and insist on controlling the situation, and also the need for maintenance and the unavailability of eyeglasses for children with small faces limit the use of virtual reality eyeglasses. Further, virtual reality eyeglasses can present as a technical obstacle that limited their access to the children's teeth.

## 6. Conclusion

For children of all ages and temperament, the impressions of distress left by the first dental visit, as well as the experience associated with each successive dental procedure, build memories that affect conduct on upcoming appointments. From our study within the limitations, we conclude that virtual reality eyeglasses are an effective distraction technique in management of pediatric patients undergoing dental treatment.

## 7. Source of Funding

None.

## 8. Conflict of Interest

The authors declare that there is no conflict of interest.

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