

# Effect of Virtual Reality Distraction on Pain and Anxiety Level among Children Aged 5-8 Years during Dental Treatment

Seema Shafeeq<sup>1</sup>, Ejaz Mahmood Qureshi<sup>2</sup>, Arooj UI Hassan<sup>3</sup>, Shafeeq Haider<sup>4</sup>, Zunaira Iqbal<sup>5</sup>, Wajiha Anwer.<sup>6</sup>

## Abstract

**Objective:** To assess the effect of Virtual Reality Distraction Technique (VRDT) on pain and anxiety among 5 to 8 years children during dental treatment and to compare the impact of Virtual Reality Distraction Technique (VRDT) vs No VRDT on pain and stress in 5 -8-year-old children during short invasive dental treatment.

**Methods:** This study was carried out in the University College of Dentistry, University of Lahore. Children were selected randomly from the OPD of the Pediatric Dentistry Department. This observational study was conducted on 64 children equally divided into two groups (32 exposed to VRDT and 32 not exposed to VRDT). Child Anxiety Related Emotional Disorders (SCARED) and Wong-Baker FACES Pain Rating Scale were used to measure anxiety and pain respectively. SPSS was used for data analysis. Mean, standard deviations, and percentages were calculated for descriptive data whereas chi-square test or independent-sample t-tests were used for mean differences in the two groups. P-value<0.05 was considered significant.

**Results:** Among all, 59.38% females and 40.63% males (5-8 years) were included. The children in the VRDT group were relatively more relaxed and reported lesser pain when injected in gums (p-values<0.05 respectively). There was no mean difference in anxiety among children in the two groups (p-value>0.05).

**Conclusion:** Anxiety during dental procedures is common among children. The visual Reality Distraction Technique (VRDT) is effective in distracting patients before and during treatment. In the present study, it helped to reduce pain frequency and made them feel relaxed. Hence, VRDT can be opted as a preferred distraction method for children to deal with their dental phobia and anxiety.

**Keywords:** Dental phobia, Fear, Anxiety, Virtual Reality, Oral Hygiene, Children, Distraction.

**IRB:** Approved by the Institutional Review Board, the University of Lahore. Ref# UCD/ERCA/21/11hi, Dated: 21<sup>th</sup> Oct, 2021.

**Citation:** Shafeeq S, Qureshi EM, Hassan AU, Haider S, Iqbal Z, Anwer W . Effect of Virtual Reality Distraction on Pain and Anxiety Level among Children Aged 5-8 Years during Dental Treatment [Online]. *Annals of ASH & KMDC*,2024;29(3): 412-419

## Introduction

Dental health is a major predictor of overall health and well-being. Especially, good oral hygiene is essential for children as their growth spurt is ac-

active and food plays a vital role in it. Dental disorders can result in excruciating pain and tooth loss which have an impact on a child's looks, food intake, and ultimately their growth and development. Increased morbidity and mortality as well as a lower quality of life are linked to poor dental hygiene. Promoting oral health care among children is a major responsibility of oral health care practitioners<sup>1</sup>. Children are also recommended regular dental visits to ensure dental health and avoid any problems such as caries. Dental caries was shown to be more common and severe due to malocclusion and irregularities in dental arches, which frequently result in pain social impairment, and functional constraint, which negatively impacts you-

<sup>1, 3, 5</sup> Department of Community and Preventive Dentistry, University College of Medicine and Dentistry, the University of Lahore.

<sup>2</sup>Department of Allied Health Sciences, University of Lahore.

<sup>4</sup>Private Consultant, Health care Management

<sup>6</sup>Dental Surgeon, Resident MSPH Agha Khan University Karachi

**Correspondence:** Dr Seema Shafeeq  
Department of Community and Preventive Dentistry,  
University College of Medicine and Dentistry,  
the University of Lahore.

Email: dr\_seema20@yahoo.com

Date of Submission: 12<sup>th</sup> February, 2024

Date of 1<sup>st</sup> Revision: 2<sup>nd</sup> September, 2024

Date of Acceptance: 29<sup>th</sup> November, 2024

ng patients. According to several studies, crowding results in incorrect tooth relationships with nearby teeth, which makes maintaining good dental hygiene challenging. Crowded teeth are harder to clean, which leads to more plaque buildup and an increased risk of periodontal and dental caries<sup>2</sup>. However, children are hesitant to visit the dentist due to anxiety and fear. Literature shows that almost 20-43% of children report dental fear. A traumatic event, such as an intense painful medical treatment or seeing a family member or friend go through one, leads a patient with associative fear of needles. Psychological symptoms including severe unexplained anxiety, obsession with the impending treatment, and panic episodes are the main causes of associative fear of needles. Fear or anxiety can significantly impact daily life, relationships, and overall well-being<sup>3</sup>. There are psychological and emotional aspects to anxiety and this fear could be due to anticipated exposure to dental equipment and a natural flinch towards expected needle pricking grinding or cutting instruments. Delusion or compulsive thoughts are the primary manifestations of anxiety and fear<sup>4</sup>. A study used the Dental Fear and Anxiety (DFA) scale to measure the level of fear and anxiety among children and found that 93.8% of students had moderate to severe DFA. Female gender and youngest age group (2-5 years) experienced more DFA. DFA leads to avoidance of dental visits, resulting in delayed diagnosis and treatment of oral health issues, progression of oral diseases, such as tooth decay and gum disease, and increased risk of complications, like abscesses and tooth loss<sup>5</sup>.

In order to deal with this fear and anxiety, dentists use a number of techniques to soothe children so that treatment can be done effectively and timely. The majority of the study's findings that there was a discernible difference in pain and behavior between the distraction technique group and the control group<sup>6</sup>. One of the main goals for dental practitioners is to provide excellent dental treatment in a stress-free setting for their patients. A pediatric dentist has a variety of strategies including conventional behavior management techniques to address dental pain and anxiety, they must use their acqui-

red knowledge and expertise to do this<sup>7</sup>. Such techniques include live modeling, tell – Show – Do, casual short talks, relaxation techniques (deep breathing, visualization), Child-friendly waiting areas and operatories and in severe cases conscious sedation and general anesthesia. These techniques temporarily help to calm patients down and let the dentist work with more attention<sup>8</sup>. Furthermore, training patients' coping abilities prior to dental procedures by showing video clips before the treatment regarding dental procedures, instruments, and how to handle them with cooperative behavior has been found to significantly reduce anxiety and avoidance of treatment but its effect is noticeable only in patients with mild anxiety. However, the usefulness of these methods is either underreported or does not have consensus in published literature<sup>9</sup>. Therefore, researchers have recently diverted their focus to some other methods especially related to distraction techniques. Distraction techniques put children's attention off of irritating stimuli or elements of fear and reduce anxiety among children during treatment. Dental practices can be adapted to make patients feel more comfortable, and additional measures can be taken to support those with moderate to severe dental anxiety. There are different ways to modify dental practices and address patient needs<sup>10</sup>.

The main strategy used by the dentist is to treat dental anxiety in children and to reduce their uncontrollable aggressive behaviors some common distraction techniques include listening to music, watching interesting media such as cartoons, and counting or observing objects around them<sup>11</sup>. Another distraction technique trending these days is Virtual Reality Exposure (VRE). Virtual reality immersion triggers the visual, aural, and tactile senses which can block the outside sensory inputs and the child is more interested in what is happening in the virtual world than in the real world. For many years, distraction has been utilized successfully in dentistry. It operates under the premise that pain perception is largely psychological, meaning that pain is felt less when attention is diverted from unpleasant stimuli. It follows that a multimodal experience like virtual reality could provide the best

distraction. By detecting head and hand movements, VR can provide kinesthetic stimuli; however, this is not suitable for use during dental procedures. As a result, an exposure-based strategy to be taken into account. Exposure therapy (ET) is indeed a highly effective treatment for specific phobias, including dental phobia. By gradually and repeatedly exposing individuals to the feared stimulus (dental procedures or environments), ET helps them become comfortable and learn to manage their anxiety by different mechanisms like Habituation, and reduced response to the feared stimulus due to repeated exposure. Extinction, learning to associate the feared stimulus with a lack of danger or harm. Cognitive changes, shifts in thinking patterns, and beliefs about the feared stimulus. Emotional processing, enhanced ability to manage and regulate emotions related to the feared stimulus<sup>12</sup>. A guided VRE can help distract patients from certain phobias and sensations of pain. This new technique is being used more frequently to treat patients with instruments provoking phobia as this technique blocks the operating field with the computer generated virtual screen. In order for VRET to benefit patients and keep them interested, the virtual setting must constantly evoke a sense of being involved during treatment<sup>13</sup>. VR is quite an attractive technique and is interactive which helps patients dissipate pain during dental procedures and controls the emotions of nervousness and anxiousness. Virtual reality exposure therapy (VRET) is a type of exposure therapy that utilizes virtual reality technology to simulate the feared environment or situation, allowing individuals to confront and overcome their fears in a controlled and safe space. By leveraging virtual reality technology, VRET offers an innovative and effective approach to exposure therapy, helping individuals overcome their fears and improve their quality of life<sup>14</sup>. Studies have reported that VR has not only shown greater patient acceptability during treatments but has also proven better anxiety control as well as more patient satisfaction. Aichmophobia, a more general term for a fear of sharp objects, is the term used to describe needle phobia, a common disorder that affects both children and adults. Virtual reality can help patients

feel less anxious by exposing them to a realistic virtual scenario and virtual dental care environment. The realism of the environment can significantly lessen the phobic illness<sup>15</sup>.

Although few studies have been conducted to see the effectiveness of VR as a mode of distraction and pain and anxiety control, local literature on this topic is almost non-existent. Also, the published international literature is of limited scope, which makes it impossible to quantify the effect of VR on pain and anxiety control among 5-8-year-old children.

To assess the effect of Virtual Reality Distraction Technique (VRDT) on pain and anxiety among 5 to 8-year-old children during dental treatment. To compare the effect of the Virtual Reality Distraction Technique (VRDT) on pain and anxiety in cases and in control (No VRDT applied) on pain and anxiety in 5 -8-year-old children during short invasive dental treatment. In the absence of nitrous oxide in dentistry, distraction techniques become a valuable tool for managing anxiety and pain in patients, especially children. Distraction techniques divert the patient's attention away from the procedure, reducing stress and discomfort. Incorporating VR into dental practices not only enhances the experience for patients but also can lead to better treatment outcomes and a more positive perception of dental care. As technology continues to evolve, the applications of VR in dentistry are likely to expand even further. By diverting a child's attention away from the procedure, distraction helps lower their anxiety levels. When children focus on something enjoyable or interesting, they are less likely to feel fearful or stressed about what is happening which can diminish the sensation of pain, making the experience more tolerable these positive experiences in the dental setting are more likely to develop a positive attitude toward future visits.

Distraction techniques in a dental setting benefit not only the patient but also the dentist. When a child is calm and relaxed, the dentist can work more efficiently and effectively, leading to better treatment outcomes.

Therefore, this study was conducted with the objective of assessing the effect of Virtual Reality Distraction Technique (VRDT) on pain and anxiety among 5 to 8 years old children during dental treatment and to compare the impact of Virtual Reality Distraction Technique (VRDT) vs No VRDT on pain and anxiety in 5 -8-year-old children during short invasive dental treatment.

## Methodology

This observational study was conducted at the Pediatric Dental Department, University of Lahore, Lahore, Pakistan. The study duration is nine months after the approval of the synopsis. Sample selection was done with the help of a non-probability purposive sampling technique. Informed consent in written obtained from all parents/guardians. There is no blinding in the study.

The sample size was estimated using the prevalence of elevated *anxiety* symptoms among children at the time of short dental intervention using the following formula taking the prevalence of anxiety symptoms among children at the time of short dental intervention as 50%. A two-tailed test was applied for two independent proportions.

$$n = \frac{\left\{ z_{1-\alpha} \sqrt{2\bar{P}(1-\bar{P})} + z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right\}^2}{(P_1 - P_2)^2}$$

Where

$n$  is the minimum sample size

$Z$  is the standard normal deviate at 95% confidence interval

$P$  = Anticipated proportion of prevalence of anxiety symptoms among children at the time of short dental intervention = 50%.<sup>16</sup> at a level of significance of 5%. Sample size ( $n$ ) calculated was 64 children equally divided into the following groups: Group A = 32 Children exposed to Virtual Reality Distraction Technique (VRDT) to lessen pain and anxiety during dental treatment and Group B= 32 Children not exposed to Virtual Reality Distraction Technique (VRDT) to lessen pain and anxiety during dental treatment.

Children, aged 5 to 8 years, visiting the pediatric dental department at the University of Lahore for dental treatment and scoring less than 25 on a Screening test for Child Anxiety Related Emotional Disorders (SCARED) questionnaire and at least one Class II cavitated carious molar (primary or permanent) requiring restoration were included. Whereas children with medical diseases like CVS, Respiratory or Neurological disorders like Epilepsy and seizures, taking medicines, having a history of behavioral disorders and history of painful invasive medical or dental procedures, those who needed to be sedated and/or managed under general anesthesia were excluded.

A proforma was generated to assess the state of anxiety in children undergoing dental procedures and was based on 8 questions with 5 picture answer options for each question. Scores on the MCDAS (f) scale ranged from 8 to 40, scores below 19 indicated the absence of a state of anxiety, scores above 19 indicated the presence of previous anxiety, while scores higher than 31, indicated severe anxiety disorder<sup>17</sup>. All of the kids were shown and given the explanation of the MCDAS(f) questionnaire, which measures state anxiety. Also, Wong-Baker FACES Pain Rating Scale this scale is used to assess the level of pain that occurs during dental treatment. This technique consisted of multiple images ranging from happy to sad faces. Patients were asked to point out perceived pain from these images immediately after treatment and also indicate the picture that can best represent the pain level that they felt during dental treatment<sup>18</sup>.

The virtual reality (VR) device consisting of glasses and headphones was used during the procedure. Glasses blocked the visual field of the child completely while the headphones delivered the sound. The device was connected to a player capable of playing MP4 audio-visual files. A single episode of a cartoon series was played for all subjects throughout the study.

Data was analyzed using SPSS version 24.0 software (SPSS Inc.). Qualitative variables such as gender, education, etc. are identified and calculated

as frequencies and percentages. Quantitative variables such as age were given as the mean ± standard deviation. Tables and bar charts were created according to the nature of the variables. A chi-square test was used to determine the sex difference between the two groups. An Independent sample t-test was used to compare the differences in age and anxiety disorders (SCARED) scores between the two groups. A p-value<0.05 was taken as statistically significant.

**Results**

In this study, there were 60% females and 41% males. Among all 64 children, 12.50% were 5 years old, 31.25% in 5-6 years of age, 25% in 6-7years and 31.25% were in the 7-8 years age category. Results of the test revealed no significant difference in the level of anxiety in children going to the dentist between groups with VR and without VR (t=-1.946, P=.056). The mean value of anxiety in the VR group was 15.38±3.26 and the without VR group was 14.0±2.31. The level of anxiety of each group was below the cut-off score of 19 and both groups had almost equal levels of anxiety. **(Table-1)**

Table 1. Anxiety Level of Children While Going to Dentist

Intervention		Mean (N=32)	Std. Deviation	T	Sig.
Anxiety Level Going to the Dentist	Without VR	14.00	2.314	-1.946	0.056
	With VR	15.38	3.260		

The results of Chi-square revealed a significant difference in anxiety levels between both groups ( $X^2 = 9.710$ ,  $P = 0.046$ ). The relaxed patients in without VR group were 3(27.3%) whereas in with VR group were 8(72.7%). Patients with very slightly worried levels in the without VR group were 5 (31.3%) whereas in the VR group, it was found in 11 (68.8%). Patients in without VR group who were fairly worried were 15(57.7%) whereas in the VR group, patients treated with VR were 11(42.3%). 75% of patients reported a lot of worriedness who were treated without VR compared to the patients treated with VR (25%). 85.7% of patients reported that they were very worried belonged to a group of patients who received treatment without VR where-

as only 14.3% reported they were very worried belonged to a group of patients treated with VR. **(Table-2)**

Table 2. Anxiety Level with Fluoride Application

Intervention	Anxiety level With Fluoride application				
	Relaxed/ not worried	Very worried	Fairly worried	Worried a lot	Very worried
Without VR	3(27.3%)	5(31.3%)	15(57.7%)	3(75%)	6(85.7%)
With VR	8(72.7%)	11(68.8%)	11(42.3%)	1(25%)	1(14.3%)
$X^2 = 9.710$ , $P = 0.046$					

The results of the Chi-square revealed a significant difference in levels of pain between both groups ( $X^2 = 22.523$ ,  $p = 0.000$ ). 61.5% of participants responded that injection in gum hurts even more who belonged to without VR group whereas only 38.5% of participants reported pain during injection in the gum were belonged to VR group. The level of pain while giving injections in gums was felt more by participants without VR (80%) as compared to the pain perception of participants who belonged to the VR group (20%). Worst pain was reported by 87.5% of participants who belonged to without VR group whereas only 12.5% of participants reported the worst pain while giving injections in gums. **(Table-3)**

Table 3. Pain Level with Injection at the Gum

Intervention	Pain level having an Injection at the Gum.					
	No Hurt	Hurts little bit	Hurts little more	Hurts even more	Hurts whole lot	Hurts worst
Without VR	1(33.3%)	2(18.2%)	2(14.3%)	8(61.5%)	12(80%)	7(87.5%)
With VR	2(66.7%)	9(81.8%)	12(85.7%)	5(38.5%)	3(20%)	1(12.5%)
$X^2 = 22.523$ , $P = .000$						

Table-4. Pain and Anxiety Stratified for Age of Patients

	5 Years				5.1-6 Years				6.1-7				7.1-8 Years			
	Without VR		With VR		Without VR		With VR		Without VR		With VR		Without VR		With VR	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Relaxed/not worried	1	3.1%	1	3.1%	1	3.1%	3	9.4%	0	0.0%	2	6.3%	1	3.1%	2	6.3%
Very slightly worried	1	3.1%	0	0.0%	2	6.3%	4	12.5%	1	3.1%	3	9.4%	1	3.1%	4	12.5%
Fairly worried	2	6.3%	2	6.3%	4	12.5%	2	6.3%	5	15.6%	3	9.4%	4	12.5%	4	12.5%
Worried a lot	0	0.0%	0	0.0%	2	6.3%	0	0.0%	0	0.0%	1	3.1%	1	3.1%	0	0.0%
Very worried	1	3.1%	0	0.0%	2	6.3%	0	0.0%	1	3.1%	0	0.0%	2	6.3%	1	3.1%
p-value	-				0.297				0.329				0.640			
(Fisher exact test)	5 Years				5.1-6 Years				6.1-7				7.1-8 Years			
No Hurt	0	0.0%	0	0.0%	0	0.0%	1	3.1%	0	0.0%	1	3.1%	1	3.1%	0	0.0%
Hurts little bit	1	3.1%	0	0.0%	0	0.0%	3	9.4%	0	0.0%	2	6.3%	1	3.1%	4	12.5%
Hurts little more	0	0.0%	3	9.4%	0	0.0%	4	12.5%	1	3.1%	2	6.3%	1	3.1%	3	9.4%
Hurts even more	1	3.1%	0	0.0%	5	15.6%	1	3.1%	1	3.1%	1	3.1%	1	3.1%	3	9.4%
Hurts whole lot	1	3.1%	0	0.0%	3	9.4%	0	0.0%	4	12.5%	3	9.4%	4	12.5%	0	0.0%
Hurts worst	2	6.3%	0	0.0%	3	9.4%	0	0.0%	1	3.1%	0	0.0%	1	3.1%	1	3.1%
p-value (Fisher exact test)	0.089				0.001				0.787				0.118			

Table 4 describes the pain and anxiety status of children in different age groups. It was observed that no significant difference was seen for anxiety between groups in all age groups. However, children who were in the VR Group were less anxious as compared to children who did not wear VR. The same trend was seen for pain status among children. However, children who were in the age group 5.1-6 years showed significantly better pain control in the VR group as compared to another group who did not wear VR.

## Discussion

Children need regular dental visits to maintain their oral hygiene and avoid any dental problems such as dental caries which is quite common among children. Oral health disorders are common and have a significant social impact as oral health is closely related to overall health. It has been observed that oral disorders in kids have an impact on their daily activities at school and at home and lower their quality of life<sup>19</sup>. However, children are usually hesitant to visit the dentist due to anxiety and fear of previous unpleasant experiences or anticipated use of sharp needles or equipment for grinding, etc. Dentists should have training in communication skills and anxiety management, these abilities enable dentists to gain more confidence and experience<sup>20</sup>. Dentists have been using conventional techniques such as listening to music or

watching cartoons, conscious sedation, and general anesthesia in severe cases to calm the children and complete the checkup<sup>21</sup>. VRE is a relatively novel approach used to distract the child during treatment, to control emotions of fear and anxiety, and to dissipate the pain temporarily. Some research findings indicate that youngsters respond better to virtual reality than adults do when it comes to pain and anxiety which might be because VR is more appealing to children as it encourages their whimsical and imaginative thinking<sup>22</sup>. Despite of international focus in this area, local literature is still very scarce and of limited scope. Previous research has validated the effectiveness of virtual reality or audiovisual distraction through video spectacles in the mitigation of dental fear and discomfort in children<sup>23</sup>. Therefore, we conducted this study to see the effectiveness of the Virtual Reality Distraction Technique (VTDT) on pain and anxiety among 5 to 8-year-old children during dental treatment. Each therapy session lasted for 30 minutes which prevented the individuals from wearing gadgets for long periods.

In the current study, 61.5% of participants responded that injection in gum was even more who belonged to without virtual reality (VR) group whereas only 38.5% of participants reported pain during giving injection of the gum that belonged to the VR group. There was a significant association

between virtual reality exposure (VRE) and pain in gums due to injection ( $p$ -value $<0.000$ ). Our study also found that children with VRE were more relaxed and felt less hurt by injection in gums ( $p$ -values $<0.05$ ).

One study conducted by Shetty and colleagues in 2019 reported that there was a remarkable reduction in pain perception and anxiety in children treated with VR distraction ( $p<0.001$ ,  $p=0.002$ )<sup>24</sup>. In another study, 117 children with a mean age of 5.4(4-6) years. They reported that in the VR exposure group, the average face pain scale was less ( $1.89 \pm 0.65$ ) compared to those without VRE ( $3.00 \pm 0.81$ ). The average faces pain scale showed a decrease in the second session after VRE compared to no VRE ( $2.05 \pm 0.60$  vs  $3.05 \pm 0.60$ ). The mean pain score in the VRE group was significantly less compared to the group without VRE<sup>25</sup>. All these studies show similar results as ours that Virtual reality is attractive, with an easy interface and effective method to distract children during dental treatments. It is important to provide an environment that gives freedom and adaptability to each patient. Overall study participants expressed a greater deal of admiration for the simulation's vibratory and auditory realism.

To further establish its efficacy, we recommend conducting more Randomized Clinical Trials (RCTs) or observational studies to compare the effects of Virtual Reality with other distraction techniques, particularly in our local context, and targeting other age groups. This will help to determine the best approaches for optimizing patient care and outcomes.

## Conclusion

This study concluded that the Visual Reality Distraction Technique (VRDT) is effective in distracting patients before and during treatment and it helps to reduce pain frequency and anxiety levels in the present study. Anxiety during dental procedures is common among children. Visual Reality Distraction Technique (VRDT) is effective in distracting patients before and during treatment and it helps to reduce pain frequency and makes them feel relaxed in the present study. Hence virtual reality distract-

ion technique can be opted as a preferred distraction method for children to deal with their dental phobia and anxiety.

**Conflict Of Interest:** None

**Disclaimer:** None

**Source of Funding:** None

## References

1. Fijaèko N, Gosak L, Cilar L, Novšak A, Creber RM, Skok P, et al. The effects of gamification and oral self-care on oral hygiene in children: Systematic search in app stores and evaluation of apps. *JMIR MHealth UHealth* 2020;8(7):1-18. [DOI: 10.2196/16365 ]
2. Kolawole KA, Folayan MO. Association between malocclusion, caries and oral hygiene in children 6 to 12 years old resident in suburban Nigeria. *BMC Oral Health* 2019;19(1):262. [DOI: 10.1186/s12903-019-0959-2 ]
3. Orenius T, LicPsych, Säillä H, Mikola K, Ristolainen L. Fear of injections and needle phobia among children and adolescents: An overview of psychological, behavioral, and contextual factors. *SAGE Open Nurs* 2018;4:1-8. [DOI: 10.1177/2377960818759442]
4. Alyami Y, Alzahrani K, Masmali A, Abulaban A, Qahwaji J, Faqehi W, et al. Dental anxiety & phobia: prevalence and most frequent causes among dentists and public in Saudi Arabia. *Int J Med Dev Ctries* 2020;4(2):325-30. [DOI: 10.24911/IJMDC.51-1575237865]
5. Sarapultseva M, Yarushina M, Kritsky I, Ibragimov R, Sarapultsev A. Prevalence of dental fear and anxiety among Russian children of different ages: The cross-sectional study. *Eur J Dent* 2020; 14(4):621-5. [DOI: 10.1055/s-0040-1714035 ]
6. Liu Y, Gu Z, Wang Y, Wu Q, Chen V, Xu X, et al. Effect of audiovisual distraction on the management of dental anxiety in children: A systematic review. *Int J Paediatr Dent* 2019;29(1):14-21 [DOI: 10.1111/ipd.12430 ]
7. Kasimoglu Y, Kocaaydin S, Karsli E, Esen M, Bektas I, Ince G, et al. Robotic approach to the reduction of dental anxiety in children. *Acta Odontol Scand* 2020;78(6):474-80. [DOI: 10.1080/00016357.2020.1800084 ]
8. Torres-Gomez J, Arnason SC, Hoopes WL, Vandewalle KS. Management of dental anxiety via distraction technique. *J Clin Exp Dent* 2021; 13(4):e350-6. [DOI: 10.4317/jced.57660 ]
9. Jongh D, Adair A, Meijerink-Anderson P. Clinical management of dental anxiety: what works for whom? *Int dent J* 2005;55(2):73-80. [DOI: 10.1111/j.1875-595x.2005.tb00037.x ]

10. Newton T, Asimakopoulou K, Daly B, Scambler S, Scott S. The management of dental anxiety: time for a sense of proportion? *Br Dent J* 2012;213(6):271-4. [DOI: 10.1038/sj.bdj.2012.830 ]
11. Folyan MO, Faponle A, Lamikanra A. Seminars on controversial issues. A review of the pharmacological approach to the management of dental anxiety in children. *Int J Paediatr Dent* 2002; 12(5):347-54. [DOI: 10.1046/j.1365-263X.2002.03812.x]
12. Cunningham A, McPolin O, Fallis R, Coyle C, Best P, McKenna G. A systematic review of the use of virtual reality or dental smartphone applications as interventions for management of pediatric dental anxiety. *BMC Oral Health* 2021;244:1-11. [DOI: 10.1186/s12903-021-01602-3 ]
13. Gujjar KR, van Wijk A, Kumar R, de Jongh A. Efficacy of virtual reality exposure therapy for the treatment of dental phobia in adults: A randomized controlled trial. *J Anxiety Disord* 2019;62:100-8. [DOI: 10.1016/j.janxdis.2018.12.001]
14. Gujjar KR, Van Wijk A, Sharma R, De Jongh A. Virtual reality exposure therapy for the treatment of dental phobia: a controlled feasibility study. *Behavioral and cognitive psychotherapy* 2018;46(3):367-73. [DOI: 10.1017/S1352465817000534 ]
15. Freitas JR, Velosa VH, Abreu LT, Jardim RL, Santos JA, Peres B, Campos PF. Virtual reality exposure treatment in phobias: a systematic review. *Psychiatric Quarterly* 2021;92(4):1685-1710. [DOI: 10.1007/s11126-021-09935-6 ]
16. Nunna M, Dasaraju RK, Kamatham R, Mallineni SK, Nuvvula S. Comparative evaluation of virtual reality distraction and counter-stimulation on dental anxiety and pain perception in children. *Journal of dental anesthesia and pain medicine* 2019;19(5):277-88. [DOI: 10.17245/jdapm.2019.19.5.277 ]
17. Klingberg G, Broberg AG. Dental fear/anxiety and dental behavior management problems in children and adolescents: a review of prevalence and concomitant psychological factors. *International journal of pediatric dentistry* 2007;17(6):391-406. [DOI: 10.1111/j.1365-263X.2007.00872.x ]
18. Shetty V, Suresh LR, Hegde AM. Effect of virtual reality distraction on pain and anxiety during dental treatment in 5 to 8 years old children. *Journal of Clinical Pediatric Dentistry*. 2019;43(2):97-102. [DOI: 10.17796/1053-4625-43.2.5 ]
19. Quadri MF, Shubayr MA, Hattan AH, Wafi SA, Jafer AH. Oral hygiene practices among Saudi Arabian children and its relation to their dental caries status. *International journal of dentistry* 2018;2018:1-6. [DOI: 10.1155/2018/3234970 ]
20. Murad MH, Ingle NA, Assery MK. Evaluating factors associated with fear and anxiety to dental treatment—A systematic review. *Journal of family medicine and primary care*. 2020;9(9):4530-5. [DOI: 10.4103/jumps.jfmpc\_607\_20 ]
21. Gujjar KR, Van Wijk A, Kumar R, De Jongh A. Are technology-based interventions effective in reducing dental anxiety in children and adults? A systematic review. *Journal of Evidence-Based Dental Practice* 2019;19(2):140-55. [DOI: 10.1016/j.jebdp.2019.01.009 ]
22. López-Valverde N, Muriel Fernandez J, López-Valverde A, Valero Juan LF, Ramírez JM, Flores Fraile J, Herrero Payo J, Blanco Antona LA, Macedo de Sousa B, Bravo M. RETRACTED: Use of Virtual Reality for the Management of Anxiety and Pain in Dental Treatments: Systematic Review and Meta-Analysis. *Journal of Clinical Medicine*. 2020;9(10):3086. [DOI: 10.3390/jcm9041025 ]
23. Buldur B, Candan M. Does virtual reality affect children's dental anxiety, pain, and behavior? A randomized, placebo-controlled, cross-over trial. *Pesquisa Brasileira em Odontopediatria e Clínica Integrada* 2020;21:1-14. [DOI: <https://doi.org/10.1590/pboci.2021.002>]
24. Khandelwal M, Shetty RM, Rath S. Effectiveness of distraction techniques in managing pediatric dental patients. *International journal of clinical pediatric dentistry* 2019;12(1):18-24. [DOI:10.5005/jp-journals-10005-1582]
25. Aminabadi NA, Erfanparast L, Sohrabi A, Oskouei SG, Naghili A. The impact of virtual reality distraction on pain and anxiety during dental treatment in 4-6 years old children: a randomized controlled clinical trial. *Journal of dental research, dental clinics, dental prospects*. 2012;6(4):117-24. [DOI: 10.5681/joddd.2012.025 ]



This open-access article distributed under the terms of the Creative Commons Attribution NonCommercial 4.0 License (CC BY-NC 4.0). To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/4.0/>