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Association between Virtual Reality Distraction on Anxiety and Pain in Primary Schoolchildren during Infection Dental Anesthesia

Shahad Jamal Al-Falahi[1], Luma Musa Ibrahim[2], Raghad H Al-Ani[3], Rehab Tahseen alhayo[4], Iman I. AL-Sheakli[5]

[1] Assistant Lecturer, Pedodontics and Prevention Department, College of Dentistry, Al-Farahidi University;
[2] Lecturer Doctor, Prosthodontic Department, College of Dentistry, Al-Farahidi University;
[3] Lecturer Doctor, Medical Chemistry, College of Dentistry, Al-Farahidi University;
[4] Assistant Lecturer, Pedodontics and Prevention Department, College of Dentistry, Al-Farahidi University;
[5] Professor, Orthodontic Department, College of Dentistry, Al-Farahidi University.
Corresponding Authurs: Shahad Jamal Al-Falahi
shahad.jalfalahi@gmail.com

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Abstract

Background: In dentistry, a variety of strategies has been employed with remarkable success in managing anxiety in young children, particularly during the administration of local anesthesia. Virtual reality is one of the most recent inventions in technology. This study sought to determine how distraction from virtual reality affected children's anxiety and pain during infiltration anesthesia. Methods: Children from primary schools between the ages of 6 and 12 who needed dental work done under infiltration anesthesia were chosen at random to participate in a test in the pediatric dentistry program at Al-Farahidy University. During the first visit, local anesthetic was given while the participants wore virtual reality goggles to view a cartoon. On their second visit, while local anesthetic was being administered, kids watched a cartoon movie on a screen. When the patient is seated in the dentist chair for the baseline measurement, when the video is on, and when topical anaesthetic is applied, the heart rate was measured using a pulse oximeter to determine anxiety in both situations. Using the Wong-Baker FACES scale, pain was assessed. Results: Overall, 50 people with an average age of 8.4 1.46 years participated. A total of 29 participants, or 58.0%, were female. The mean heart rate of the test group was considerably higher than that of the control group at every time point except baseline. Regardless of the distraction approach used, multiple regression analysis revealed that younger individuals and females had higher mean FLACC behavioural pain assessment scale ratings ($P = 0.034$ and $P = 0.004$, respectively). After adjusting for all other factors, people who were younger and those with greater baseline heart rates reported higher mean Wong-Baker FACES pain rating scale scores ($P = 0.031$ and $P = 0.010$, respectively).

Conclusion: Regardless of the type of distraction utilised, women and younger age groups were more likely to report experiencing more discomfort following local anaesthetic injection.

Keywords : pain, virtual reality distraction, infiltration anesthesia, primary schoolchildren, anxiety

Trial registration: Between March and April 2022, the trial was retroactively registered in the pediatric department at Al-Farahidy University/College of Dentistry.

Introduction

Dental care frequently involves pain, especially when invasive treatments like tooth extractions or dental fillings are performed (Costa *et al.*, 2012). Children can feel discomfort and anxiety during dental treatment, and local analgesics are frequently given for helping reduce patients' pain(Guelman, 2005). Dental treatment that causes pain or anxiety can have a number of unfavorable effects on the patient, including increased dental dread, difficult conduct, and an overall dissatisfaction with dental care (Guelman, 2005). The local anesthetic injection is reportedly the most dreaded aspect of a dental visit. High levels of anxiety are linked to local anesthetic, which emphasizes the significance of behavior control in pediatric treatment.

The American Academy of Paediatric Dentistry (AAPD) defines distraction as "the technique of diverting the patient's attention from what may be perceived as an unpleasant procedure" and notes that it is one of the behavior-guiding tactics.(2015). Young patients' anxiety has been significantly reduced by the use of multimedia diversionary techniques in dental offices. Al-Khotani A. et al. (2016); El-Sharkawi HF et al. (2012). With the aim of assisting in patient behaviour control, virtual reality (VR) distraction is a relatively new. For a variety of dental procedures, including basic anaesthesia, periodontal, restorative, and pulpal therapy, dispersion using virtual reality (VR) gave excellent results in both adult and paediatric patients.(Al-Halabi et al., 2018; Bagattoni S et al., 2018; Shetty V et al., 2019).

Patients who underwent VR distraction had much less pain relief than those who did not in a study that looked at how it affected inferior alveolar nerve block and pulpal treatment.(Panda A, 2017). There have been no research specifically on buccal infiltration anesthetic, despite the fact that pediatric patients respond more well to inferior alveolar nerve block than to buccal infiltration injection. (Ram D. and Peretz B., 2001). In our study, we investigated how children's anxiety and pain during buccal infusion anaesthesia were influenced by virtual reality distraction. In order to reduce the discomfort and anxiety of paediatric patients undergoing buccal infusion anaesthesia, we hypothesised that virtual reality distraction would be used.

Methods

Between March and April 2022, a cross-sectional study was carried out at the Pediatric Dentistry division of Al-Farahidi University's Faculty of Dentistry in Baghdad, Iraq. Children between the ages of 6 and 12 who were in good health and cooperative and required non-urgent dental care under local anesthetic buccal infusion by a pediatric dentistry student or postgraduate intern were eligible for the study.

The children were subjected for two dental treatment visits, During the first visit, a video from a list of well-known animated series was requested. The chosen film was played while they wore VR goggles (the LG 360 virtual reality [VR] headset, manufactured by LG Electronics). In the second visit, On a screen connected to a computer situated next to the dental chair, the selected video was being played. Buccal infiltration local anaesthetic was administered to all patients. After the mucosa was dried with cotton rolls and 20% benzocaine topical anaesthetic gel (Sky- Caine Gel, Skydent Inc., NY, USA) was applied for 20 seconds, mepivacaine 2% with 1/100,000 epinephrine (Scandicaine 2% speciale, Septodont, UK) was injected. The subject's dentist (posdoctoral paediatric dentistry students or dental interns) administered the anaesthesia to the patient.

A pulse oximeter (OxyWatch, ChoiceMMed, Hamburg, Germany) was used to monitor the subjects' heart rates (HR) at three different time intervals: (1) at baseline, when the individual is seated in the dental chair; (2) when the film starts playing (approximately three minutes later); (3) at needle insertion (about two minutes later). The individuals were positioned upright after receiving local anaesthetic, and they were then shown the Arabic version of the Wong-Baker FACES pain rating scale. They were then asked to select the face that best represented how they felt while the local anesthesia was being administered (Baker CM et al., 1987 Using the HR data from Nuvvula et al., 2015, sample size was determined. At 0.05 significance level and 95% power, it was discovered that 50 people were needed for there to be a statistically significant difference between the two groups. It was shown that a statistically significant difference between the two groups required 50 participants at 0.05 significance level and 95% power. At a significance threshold of 0.05, the baseline characteristics, HR, and Wong-Baker FACES pain rating scale score were compared between the test and control groups using the Mann-Whitney U and Chi-square tests. A two-way mixed ANCOVA test was employed to look into any interactions between age, gender, and time points because HR was recorded at various intervals. The Wong-Baker FACES pain rating scale was used to model the impact of VR on scores, and ordinal logistic regression was used to look for interactions and adjust for any potential age, gender, and baseline HR confounding.

Result

As seen in figure (1), local anesthetic was administered after randomization, allocation, and completion. A total of 50 schoolchildren access to study. They were 27 girl and 23 boy ages between 6-12. 13 girls and 8 boys were between 6-8 years old; and 14 girl and 15 boy between 9-12 years old as shown ion table (2).

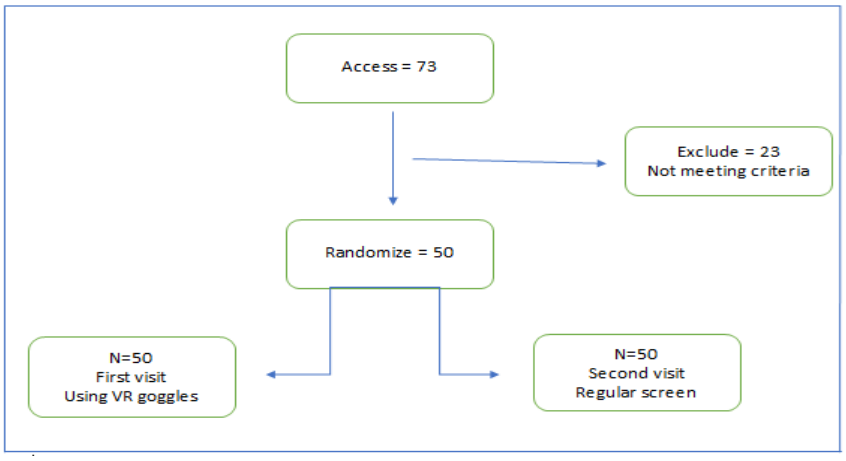

Fig (1) Flowchart for subject recruitment, randomization, allocation, and delivery of local anesthetic.

Table (1) shows the distribution of children, they were twenty-seven girl and twenty-three boy.

gender	no.	percentage
girl	27	54%
boy	23	46%
total	50	100%

Table (2) shows the children age distribution. They were thirteen girls age between 6-8 and eight boys while fourteen girl and fifteen boy ages between 9-12.

age	girls	boys	total
6-8	13	8	21
9-12	14	15	29
total	27	23	50

Table (3) shows the different of anxiety and pain between the first and the second visit. The heart rate was reduced during the first visit with the use of VR goggles in compared with the second visit, the result was statistically significant. The Wong– Baker FACES pain rating scale score shows reducing in pain in the first visit regarding the second visit but it was statically not significant

variables	first visit mean	second visit mean	p-value
heart rate			
-sittin on chair	85.18 ± 11.51	93.14 ± 15.52	0.094*
-vedio on	82.23 ± 10.37	90.62 ± 15.34	0.063*
-needle insertion	88.98 ± 15.61	101.29 ± 15.75	0.008*
Wong-baker face pain rate	2.17 ± 2.29	2.31 ± 2.72	0.129

* Statistically significant

Table (4) shows the degree of pain and the differences in pain felling between the first and the second visit. It shows that during the first visit with the use of VR goggles in compared with the second visit they have a little pain degree in both gender and through different ages of the children.

Table (4) Association between gender, age and pain according to the Wong– Baker FACES pain rating scale score

gender	**age**	**degree of pain**	**First visit no (%)**	**second visit no (%)**
Girls	6-8	0	10 (76.9)	8 (61.5)
		1	2 (15.4)	3 (23.1
		2	1 (7.7)	2 (14.4)
	9-12	0	12 (85.8)	9 (64.3)
		1	1 (7.1)	3 (21.4)
		2	1 (7.1)	2 (14.3)
boys	6-8	0	4 (50.0)	2 (25.0)
		1	2 (25.0)	3 (37.5)
		2	2 (25.0)	3 (37.5)
	9-12	0	8 (53.3)	4 (26.7)
		1	4 (26.7)	6 (40.0)
		2	3 (20.0)	5 (33.3)

Discussion

Unfavourable past dental experiences, particularly ones involving local anaesthetic, have been linked to increased levels of dental anxiety, challenging behaviour during treatment, and a propensity to miss future dental appointments. (El-Housseiny *et al.*, 2014). The goal of our study was to determine how children's anxiety and discomfort levels during infiltration anaesthesia were altered by VR distraction. Children aged 6 to 12 were the focus of our study because they are able to fully grasp the fun and thrill of donning a VR device and can

become fully engrossed in the experience. They are old enough to independently respond to inquiries regarding pain levels.

A physiological measure of anxiety was chosen, HR, and a subjective pain scale, the Wong Baker FACES pain rating scale, to quantify both anxiety and pain. The HR was employed to convey the degree of anxiety experienced throughout various anesthetic administration procedures. In particular, in studies of children's dental behavior, the use of heart rate to evaluate and detect changes in the level of anxiety in children undergoing dental treatment is expanding (Jimeno *et al.*, 2011). Heart rate is considered to be a reliable and sensitive indicator of a child's nervousness throughout various dental operations.

The results of our analysis showed that the baseline HR was lower at the first visit than it was at the second, despite the fact that the individuals were assigned at random, which was most likely an accident. In the analyses that followed, it was necessary to take this divergence into account.

These results are in opposition to two prior studies that assessed the use of tablets as distraction tools while wearing audiovisual spectacles and discovered that the tablet distraction was associated with a larger increase in heart rate. (Al-Halabi *et al.*, 2018; Attar and Baghdadi, 2015). Similar to our findings, other research revealed that the usage of VR distraction decreased heart rate. (Hua *et al.*, 2015; Kaur *et al* .,2015).

The Wong-Baker FACES pain rating scale is widely accepted as a valid measure for assessing children's self-reported pain, according to numerous research. In comparison to other pain scales, it has excellent sensitivity and validity, is easy to use, and is favoured by pediatric patients (Shindova and Belcheva , 2016). When compared to the traditional behavior management techniques used in the medical and dental industries, VR distraction has been demonstrated to be beneficial in lowering pain and anxiety. In phlebotomy operations, VR dramatically decreased acute procedural discomfort and anxiety, according to (Gold and Mahrer, 2018). Another study that contrasted virtual reality distraction with traditional behaviour control techniques found that VR distraction reduced the discomfort of invasive dental procedures including extractions and fillings(Atzori B. et al., 2018). In the present study, we contrasted the use of virtual reality (VR) distraction with an active control (regular screen), and we found that, in comparison to the conventional audiovisual distraction using the regular screen, using VR distraction had no additional benefits, neither on HR nor pain reduction, during infiltration anaesthesia. These findings are consistent with those of Al Halabi et al. (2018), who looked at how distraction from VR impacted pain and anxiety in young patients receiving inferior alveolar nerve blockade. As opposed to that, Attar et al. discovered that utilizing video glasses resulted in greater pain levels when compared to using an iPad (Attar and Baghdadi, 2015).

On the other hand, like in our investigation, several studies (Aminabadi *et al.*, 2012; Panda , 2017) discovered a favorable effect of VR distraction on pain and anxiety. When treating pediatric patients between the ages of 4 and 6 while being distracted by VR goggles, Aminabadi *et al.*'s study from 2012 revealed a significant reduction in pain and anxiety scores (Aminabadi *et al.*, 2012). Additionally, Panda (2017) noted that the usage of VR eyewear dramatically decreased the amount of pain experienced by (6-8) years old children undergoing dental treatment.

Throughout the whole dental treatment in these investigations, which included anesthesia and restorative or pulpal therapy, VR was employed as a technique of distraction. The longer duration of VR distraction, which enables a more immersive effect on subjects, may account for the difference in outcomes. Another explanation for the reduced level of discomfort could be that the dental work was done after a successful anesthetic was achieved, rendering the remainder of the VR distraction painless.

Future research should compare how well integrated eye tracking VR systems perform in lowering pain and discomfort in paediatric dentistry patients to more traditional VR systems. The effectiveness of VR analgesia during dental procedures may significantly change as VR technology advances. Better resolution and wider field VR devices were found to be significantly more effective at reducing thermal pain on the skin and the amount of time spent thinking about the pain when compared to low resolution and narrow field VR systems. Other intriguing research areas in this field are the patient's satisfaction and enjoyment of the virtual reality experience during dental visits.

Conclusion : Virtual reality goggles were more effective than screen distraction at reducing heart rate and discomfort in young patients receiving buccal infusion anaesthesia. Regardless of the type of distraction used,

boys, younger adults, and patients with higher baseline heart rates were more likely to report higher pain levels following local anaesthetic injection. The impact of virtual reality distraction on other non-sedation dentistry procedures has to be studied further.

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