



Effect of Virtual Reality as a Distraction Technique on Pain and Anxiety Levels in Pediatric Dental Patients

Sara Faisal Hamdy¹, Mohamed Sherif Mohamed Salah Eldin Hassan Farag², Asmaa Ali Abo El-Soud³

Department of Pediatric Dentistry, Preventive Dentistry and Dental Public Health, Faculty of Dentistry, Suez Canal University, Ismailia, Egypt

Department of Pediatric Dentistry, Preventive Dentistry and Dental Public Health, Faculty of Dentistry, Suez Canal University, Ismailia, Egypt

Department of Pediatric Dentistry, Preventive Dentistry and Dental Public Health, Faculty of Dentistry, Suez Canal University, Ismailia, Egypt

Corresponding author's: Sara Faisal Hamdy^{1*},

Email: Sara_hamdy@dent.suez.edu.eg

Abstract

Aim: The aim of this study was to examine whether screening content through virtual reality (VR) goggles can diminish pain perception during local anesthesia administered using the inferior alveolar nerve block technique in routine pediatric dental treatment.

Materials and methods: This is a crossover study of healthy young adults aged from 12 to 14 years old who were scheduled to receive local anesthesia administered using the inferior alveolar nerve block technique. The participants were randomly assigned to undergo treatment performed while playing video games with VR glasses (study group) and the other treatment with tell-show-do technique (control group). The pain & anxiety were evaluated using heart rate and a modified dental anxiety scale.

¹ Student of Master Degree, Department of Pediatric and Preventive Dentistry and Dental Public Health, Faculty of Dentistry, Suez Canal University, Ismailia, Egypt

² Professor and Head of Department of Pediatric and Preventive Dentistry and Dental Public Health, Faculty of Dentistry, Suez Canal University, Ismailia, Egypt

³ Associate Professor of Pediatric and Preventive Dentistry and Dental Public Health, Faculty of Dentistry, Suez Canal University, Ismailia, Egypt

Results: There was no significant difference between the control and study group in heart rate, but there was a significant difference in the modified dental anxiety scale between the control and study group.

Conclusions: VR can decrease pain and anxiety during the administration of IANB.

Keywords: dental anxiety, pain, VR glasses, active distraction technique.

Introduction:

Distraction is a behavior management method used during procedures that may be painful or uncomfortable. The rationale is to reduce a patient's attention from cultivating pain signals and thus diminish the pain experience. (1) An ideal distractor involves a number of senses and triggers emotional reactions that assure that the patient is focused on the distracting element. (1) Distraction techniques include playing music, storytelling, watching television, and using audiovisual distractions. (2) Virtual reality (VR) is an interactive computer-generated experience using a head-mounted display, which creates an immersive experience through visual and sound effects and enables dynamic interaction of the user in a virtual environment. An advantage of the VR technique over traditional behavior management distractors is that it blocks the patient's view of the possibly stressful environment and projects relaxing content that the patient can choose. (1,2) Distraction using VR has been shown to be an effective intervention for reducing pain in children undergoing needle-related medical procedures. (2) Painful dental operations cause fear, and fear and anxiety can increase the amount of perceived pain. (3).

Therefore, the objective of the current study was to examine whether the use of VR goggles as an active distraction technique in routine pediatric dental treatment can reduce pain perception during local anesthesia

Materials and methods:

Methodology:

The sample size for this study was calculated according to **Jaykaran and Tamghna [4]**, who used the following equation:

$$N = \frac{(Z_{\alpha})^2 * (S)^2}{(d)^2}$$

N = Total sample size

Z_{α} = Is Standard normal variate and its equal 1.96 at $P < 0.05$

SD = Standard deviation of a variable

d = Absolute error or precision

Z_{α}	SD	d
1.96	9.68	2

Total sample size $N = \frac{(1.96)^2 \times (9.68)^2}{(2)^2} = 30$ sample

The patients were selected from the Outpatient Clinic of Pediatric Dentistry and Dental Public Health Department at the Faculty of Dentistry, Suez Canal University, Approval from the Research Ethics Committee (REC), Faculty of Dentistry, Suez Canal University (No.144/2018) was obtained. That was in full accordance with the World Medical Association Declaration of Helsinki (version 2008), In addition to the written informed consent that was obtained for each patient from their legal guardian indicating their agreement for their children to take part in the study, the study procedures were explained to the patients and their parents.

The inclusion criteria were children aged from four to six and from twelve to fourteen years, patients belonging to the Frankel scale scoring 3 and 4, children appearing healthy, patients who needed dental intervention in their lower molars, written informed consent was taken from parents or caregivers. The exclusion criteria were children with any visual or auditory defect, language barrier, and previous invasive or painful dental or medical history

Each patient was allowed to select one card from a bowl, which contains 30 cards are equally distributed either A,B (15 for each)

Assessment methods:

- Physiological measurements were measured by pulse rate by using a pulse oximeter device and psychological measurement by using a modified dental anxiety scale.

Clinical steps:

1-Patients selection was done according to inclusion and exclusion criteria, Personal history was taken, Clinical and radiographic examination to the selected children was done, and Informed consent was taken from the parents or caregiver, The children in the study group during VR session, once seated in the dental chair would be allowed to use the VR device before beginning the dental treatment and administering the local anesthetic, (6) pulse rate was recorded directly by pulse oximeter while the patient was sitting comfortably on the dental chair (7), the topical anesthetic gel was applied after drying the injection area for 30 seconds, then followed by the inferior alveolar nerve block The second Pulse rate was immediately recorded again after the anesthesia.

The psychological measurements were assessed by a modified dental anxiety scale, by asking patients five questions (multiple choice questions) (2) to define their anxiety level towards the next dental procedures on the dental chair by Modified Dental Anxiety Scale

Results

30 patients (young adults from twelve to fourteen years), were divided into two groups according to the used type of management technique, the control group by using the tell-show-do technique, and the study group by playing video games using virtual reality eyeglasses as an active distraction technique.

All data were collected, calculated, tabulated, and statistically analyzed using the following statistical tests. A normality test (Kolmogorov-Smirnov) was done to check the normal distribution of the sample.

Descriptive statistics were calculated in the form of Mean \pm Standard deviation (SD). The Kruskal-Wallis test was used to compare between groups for each variable. The chi-square test was used to evaluate qualitative data between the groups. Paired sample-t-test was used to compare between groups. P value ≤ 0.05 is considered be statistically significant. All statistical analysis were performed using the computer program SPSS software for windows version 22.0 (Statistical Package for Social Science, Armonk, NY: IBM Corp) at significant levels 0.05 (P- Value ≤ 0.5).

Regarding the physiological parameters, Changes in heart rate: The results used a dependent t-test showed a non-significant difference between before and after anesthesia in heart rate in both groups **Figure (1)**

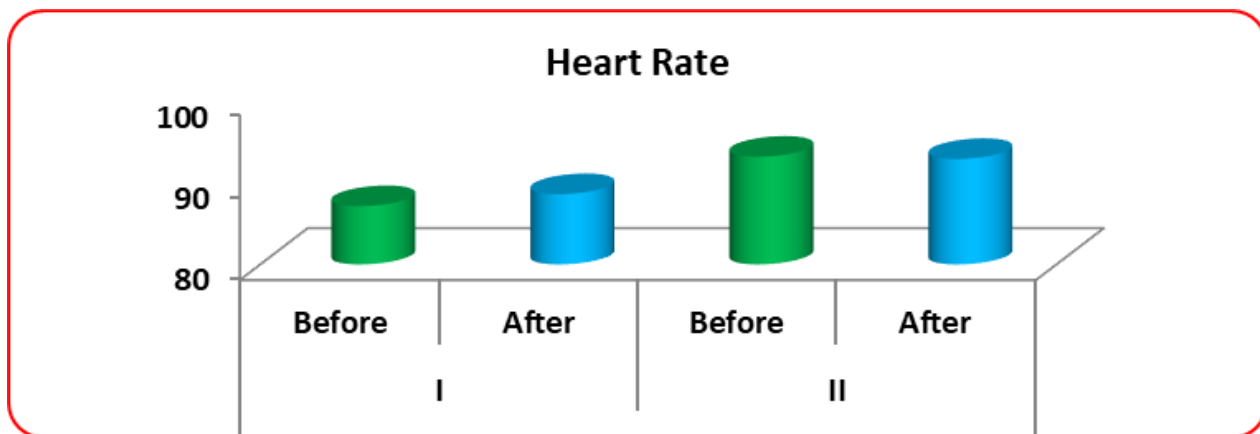


Figure (1)

In the Modified Dental Anxiety Scale results using chi square test: According to Dental Anxiety Scale, Using the chi-square test statistical analysis showed significant differences between control and study group. **Figure (2)**

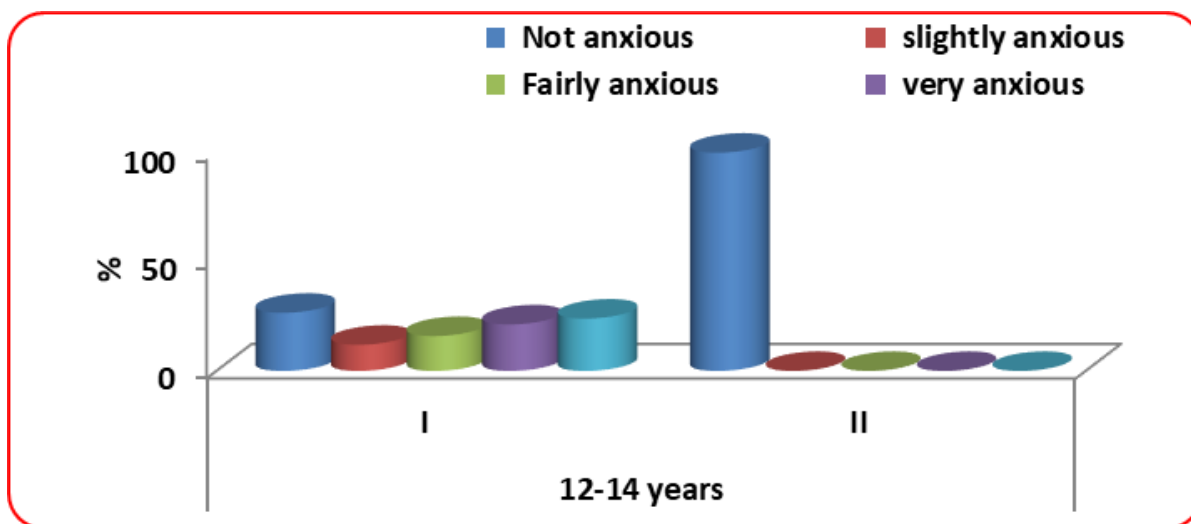


Figure (2)

Discussion:

Virtual reality aims to distract a person's attention from the real world, making it less likely for them to perceive unpleasant stimuli. The level of immersion of the stimuli affects the extent of sensory shielding, which can reduce pain. This was observed in **McCaffery and Pasero, [8]**.

In our study is that we are using a Samsung headgear VR headset for playing VR video games by young adults, as many studies had been made before on children, but not many studies were made on young adults, the young adult group (from 12 to 14 years), the young adults are a very important age as this is the age where the children leave the primary school and start feeling they are not children anymore.

This study concerned evaluating pain and anxiety during the administration of local anesthesia via needle, which is the most painful and stressful part of dental treatment. Unfortunately, many children and adults avoid dental care because they experience pain and anxiety before or during an injection, which remains a barrier to receiving dental treatment [9].

Tell-show-do was used in the control group as a management technique, as it is simple and accepted by most patients and is mostly used [10].

The audiovisual Distraction technique was used in the study group as it intends to move the patient's attention away from the treatment procedure. This could be in the form of cartoons, music, books, or stories, there are two types of distraction techniques either passive distraction technique or active distraction technique (2), we used in our study active distraction technique as the young adults will be more interested in playing video games as an active distraction more than watching shows as a passive distraction technique.

This study's findings suggest that using VR glasses as an audiovisual active distraction technique can decrease pain and anxiety perceived by young adults during dental treatment. There was no significant difference in heart rate, before and after anesthesia in young adults from 12 to 14 years. However, there was a significant difference with VR glasses group in the modified dental anxiety scale.

For heart rate This is in contrast to **Mitrakul K. et al., (11)**, **Al-khotani A. et al., (12)** **Khanapurkar PM et al., (13)**; who made their studies on 7 to 11 years patients found reduced heart rates in patients who had their dental treatment with VR distraction compared to without VR.

This is in agreement with **Al-Halabi et al., (14)**, who didn't find any significant difference while using VR glasses.

For psychological outcome results with respect to Significant differences were observed between the control group and study groups using the Modified Dental Anxiety tests, in agreement with studies **by Aminabadi et al. [15], Niharika et al. [1]**. However, **Jimeno G. and et al. [16]** found no significant differences in audiovisual distraction in children aged 6 to 8.

Within the limitations of this study; VR headgear needs to be in a smaller size suitable for dental use, dentists must have basic knowledge of the hardware and software of the goggles, other studies with larger sample sizes need to be done.

In conclusion, the use of VR glasses as an active distraction technique decreased the pain perceived during the administration of IANB in young adults.

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Competing interests

No conflict exists.

References:

1. **Niharika P, Venugopal R, Srujana P.** Effects of distraction using virtual reality technology on pain perception and anxiety levels in children during pulp therapy of primary molars, 2018 J of Indi Soc of Pedods and Preven Dent.

2. **Pande P, Vivek R, Nikhil S.** Effectiveness of different behavior guidance techniques in managing children with negative behavior in a dental setting: A randomized control study. *J of Ind Soc of Pedodo and Preven Dent*; 2020; 259-265.
3. **Seligman D, Hovey K, Thomas H.** **Dental anxiety:** An understudied problem in youth, clinical psychology review 55(2017) 25-40.
4. **Jaykaran, C and Tamoghna, B.** (2013) How to Calculate Sample Size for Different Study Designs in Medical Research? *Indian J Psychol Med.* 2013; 35(2): 121–126.
5. **Mitrakul K, Asvanund M, Arunakul S. Paka-A,** Effect of audiovisual eyeglasses during dental treatment in 5-8 year-old children, *Europ J of ped dent* 2015 vol. 16/3.
6. **Khanapurkar P, Devendra I, Gagandeep L.** Effect of virtual reality distraction on pain and anxiety during local anesthesia injection in children – a randomized controlled cross-over clinical study ,*Journal of Advanced Medical and Dental Sciences Research* 2018|Vol. 6|Issue 11|.
7. **Vijender k., Bhawna G, Jaskiran K.** Evaluation of Anxiety Level of Children Aged 6 - 9 Years During Sequential Dental Visits Using Objective and Subjective Measures. *EC Dental Science* 15.4 (2017): 93-103
8. **McCaffery M, Pasero C.** Practical nondrug approaches to pain. In *Pain: Clinical Manual.* St. Louis, MO: Mosby, 1999, 399–427.
9. **Kumor V, Soma S, Neeraja T.** Prevalence of dental anxiety level in 6- to 12-year-old South Indian children." *J of Pharm and Bio Allied Sci*, vol. 11, no. 6, 2020, p. 321
10. **Pande P, Vivek R, Nikhil S.** Effectiveness of different behavior guidance techniques in managing children with negative behavior in a dental setting: A randomized control study. *J of Ind Soc of Pedodo and Preven Dent*; 2020; 259-265.
11. **Mitrakul K, Asvanund M, Arunakul S. Paka-A,** Effect of audiovisual eyeglasses during dental treatment in 5-8 year-old children, *Europ J of ped dent* 2015 vol. 16/3.
12. **Al-Khotani A, Lanre A, Nikolaos C.** Effects of audiovisual distraction on children’s behavior during dental treatment: a randomized controlled clinical trial, *ACTA Odontologica Scandinavica*, 2016.
13. **Khanapurkar P, Devendra I, Gagandeep L.** Effect of virtual reality distraction on pain and anxiety during local anesthesia injection in children – a randomized controlled cross-over clinical study ,*Journal of Advanced Medical and Dental Sciences Research* 2018|Vol. 6|Issue 11|.

- 14. Al-Halabi M, Nada B, Zuhair A.** Effectiveness of audiovisual distraction using virtual reality eyeglasses versus tablet device in child behavioral management during inferior alveolar nerve block, anaesth, pain & intensive care; 2018vol 22(1) JAN-MAR.
- 15. Aminabadi N, Leila E, Azin S, Sina G.** The Impact of Virtual Reality Distraction on Pain and Anxiety during Dental Treatment in 4-6 Year-Old Children: a Randomized Controlled Clinical Trial4, J Dent Res Dent Clin Dent Prospects. 2012; 6(4): 117–124.
- 16. Jimeno F, Guinot S, Yuste Bielsa C.** Objective and subjective measures for assessing anxiety in paediatric dental patients, European journal of paediatric dentistry • vol. 12/4-2011