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The effect of video games on the behavioral response and self-assessment of pain prior to inferior alveolar nerve block administration in children

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Abstract

Background: Local anesthesia injection is one of the painful and stressful experiences in children during dental procedures. Distraction is one of the non-pharmacological methods for controlling pain during treatments. Using video games is one of the distraction methods. The aim of the present study was to determine the effect of video game distraction on pain control during the inferior alveolar nerve block administration in 6-9-year-old children.

Methods: This is a randomized controlled clinical trial, in which 33 girls and 27 boys were divided into control and experimental groups. The experimental group was provided with a video game prior to the anesthesia injection, but the control group only had the parents by their side. Children's behavioral response during anesthesia injection was measured by the face, legs, activity, cry and consolability (FLACC) scale and the Wong Baker Faces Pain Self-Rating Scale. The obtained results were analyzed using independent t-test, chi square, Mann-Whitney and Kruskal-Wallis tests in SPSS ver. 16.

Results: FLACC scale showed a statistically significant difference between the control and experimental groups (P = 0.013). That is the mean pain score in the experimental group (1.1 ± 10.18) is lower than the control group (2.2 ± 86.24). Also, Wong Baker scale also showed a statistically significant difference between the control and experimental groups in terms of the mean pain self-assessment score (P <0.0001). That is, the mean pain score in the experimental group (1.1 ± 67.82) was lower than that in the control group (4.2 ±62.82).

Conclusion: The results of the present study showed that video games have a positive and significant effect on pain control during the inferior alveolar nerve block among 6-9-year-old children.

Key Words: Distraction, Pain control, Pediatric dentistry, Video games.

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1- INTRODUCTION

Pain is "an unpleasant sensation or experience associated with actual or potential tissue damage", as defined by the World Health Organization in 2015 (1, 2). Pain is a mental experience with cognitive, behavioral and emotional dimensions that is influenced by environmental, social, cultural and developmental factors of an individual (3). Experiencing pain and anxiety can lead to several negative consequences, including higher levels of dentophobia, lack of cooperation, and general patient dissatisfaction with dental care (4). At the first visit to the dentist, pediatric patients are often anxious and worried about the new dental experience and equipment (5). One of the main desires of dental professionals is to treat their patients in an anxiety-free environment with a high-quality dental care. To achieve this goal, dentists must apply their skills and experiences (6, 7). According to McCaul & Mallot's theory, a patient's perception of pain decreases when distracted by an unpleasant stimulus. Distraction reduces pain and behavioral distraction by diverting children's attention from painful stimuli during the invasive stages of dentistry (8-10). Distractions fall into two main categories: Passive distractions include watching movies, listening to music with headphones, and reading a book or story to a child. Active distractions, on the other hand, include singing, pushing the ball, breathing exercises for relaxation, and playing with electronic devices by the child (9, 11). As cognitive-emotional and neurocognitive models predict, active distraction is significantly more effective than passive distraction (12). Pain distraction interventions fall into three main categories (cognitive, behavioral, or combination of both) (13).

Distraction as a non-pharmacological method has been more attractive to children considering its lower costs and side effects and higher success (14, 15). Video games, as one of the methods to create distractions, have become a pervasive activity in society today. Children may become so engrossed in video games that they become oblivious to their surroundings or ignore verbal and tactile stimuli. Video games have a wide range of applications in healthcare, mainly for distraction and behavior modification purposes (16-18). Previous studies have not investigated the effect of video game distraction on inferior alveolar nerve block administration (19-22). Some studies investigated not only the injection but also the entire dental treatment in different age ranges of children (23, 24). Generally, in these studies, very diverse age ranges have been considered (19, 24, 25). The main purpose of the present study is to create an active distraction by engaging a child with video games on a mobile phone during the inferior alveolar nerve block injection in children aged 6-9 years and determining its effect on their pain control.

2- METHODS

2-1. Study design and population

This is a randomized controlled clinical trial that aims to investigate the effect of video games as one of the methods of distraction in controlling pain during inferior alveolar nerve block injection among children aged 6 to 9 years referring to a pediatric dentist's office in 2020-2021.

To determine the sample size, a similar article entitled "The effect of audio-visual distraction on children's behavior during dental treatment: a randomized controlled clinical trial" was used (23). The mean ± standard deviation of pain in the intervention and the control groups after the intervention was 0.14 ±0.36 and 0.75 ± 0.52, respectively. The sample size was estimated as 17 people in each group using the following formula taking into account Type I error=1%, with 95% confidence

level, and power of 80%. In order to increase the accuracy of the study, the sample size was increased to 30 people in each group.

Using the convenience sampling method and based on a random numbers table, the children were assigned to the control and experimental groups (26). The CONSORT Flow Diagram (**fig. 1**) displays the assignment of eligible individuals to the groups. We included children who were in the Frankl Grade 3 and 4 (cooperative and very cooperative) during dental work. If the child wished to continue playing during the treatment process, the game was provided to the child.

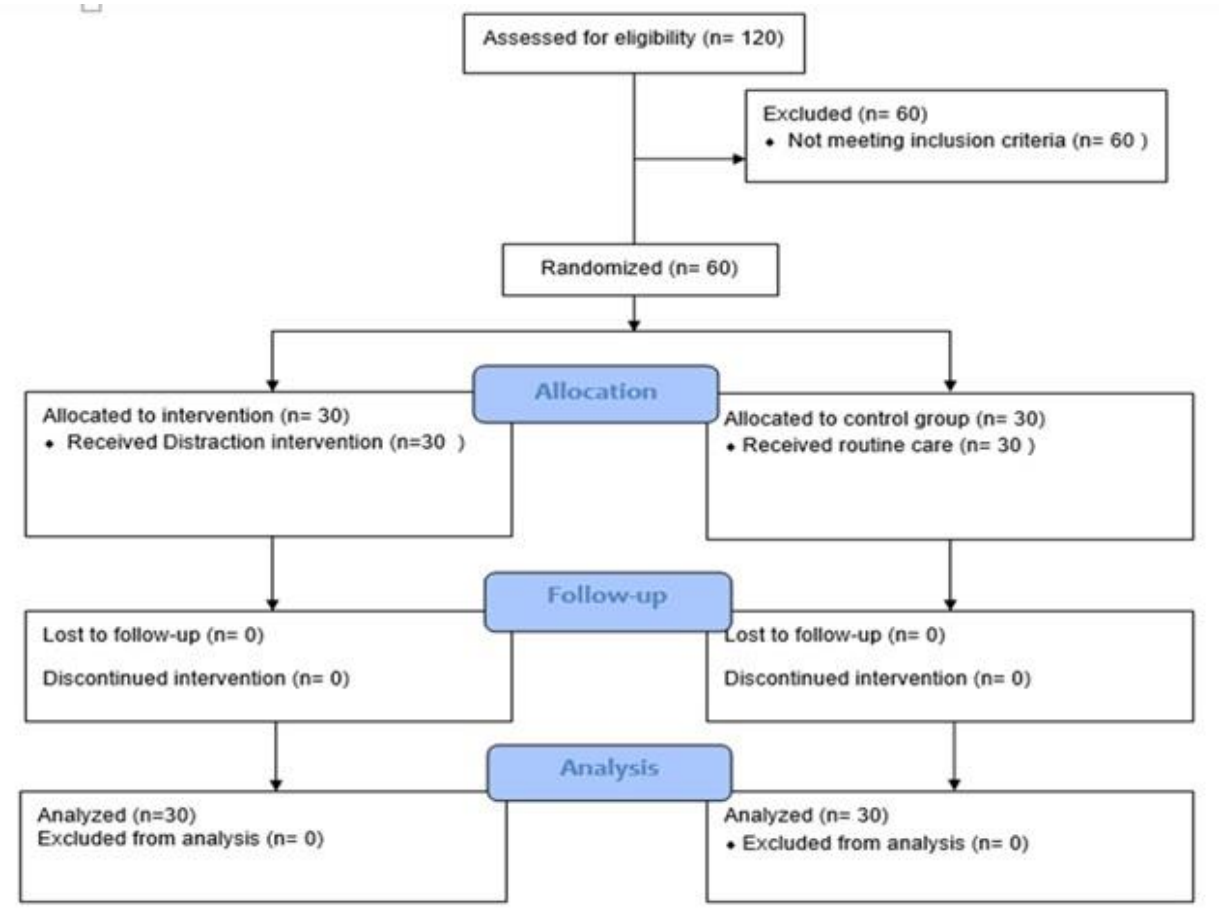

Fig. 1: CONSORT Flow Diagram for the sampling procedure

2-2. Inclusion and Exclusion criteria

2-2.1. The Inclusion criteria included

1) Lack of previous experience with dental procedures.

2) Lack of severe nausea during dental procedures (GAG reflex) (27).

3) Patients aged 6-9 years.

4) Patients in need of treatment in the mandible.

5) Patients in need of the inferior alveolar nerve block anesthesia.

6) The presence of the parents with the child.

7) Absence of mental, behavioral, auditory and visual impairment, no acute and chronic disease.

8) Having the ability to communicate (26).

2-2.2. Exclusion criteria included:

1) Severe pain.

2) Occurrence of emergency accidents such as hypoglycemic shock (28).

2-3. Clinical Interventions

A standard text was read for both groups to create verbal distraction. For initial mucosal anesthesia, a cotton roll impregnated with 20% topical benzocaine gel was used for 30 seconds after drying the mucosa with a sterile gauze. For the main injection, a 2% carpal lidocaine containing epinephrine 1.80000 (Daroo Pakhsh, Tehran, Iran) and a 27-gauge needle were used.

To perform the injection, the pediatric dentist, without showing the syringe, attended on top of the patient's head and placed his/her left hand between the patient and the syringe so that the patient would not notice the syringe entering his mouth. After the injection, to explain the pain, (s) he tells the child "tooth worms, seemingly, do not want to come out of the mouth." All injections were performed by the same pediatric dentist (27).

Five minutes prior to the inferior alveolar nerve block anesthetic injection, the distraction process for the intervention group began with a video game on a mobile phone provided to the subjects. At the end of the injection and before starting the treatment, the subjects could use the game. The video game used was related to SEGA series Sonic games. In both groups, one parent was present during the treatment process (26).

2-4. Instrument

Besides the medical and dental reports of the patients, a questionnaire asking for the child's demographic, medical and dental information (sex, age, reasons for visiting the dentist) and FLACC scale for children, and Wong-Baker Faces Pain Scale were applied for data collection. The assessor was a pediatric dentist in the present study. The medical and demographic questionnaire was completed through an interview with a parent.

a) FLACC Scale

This is a behavioral scale for measuring postoperative pain intensity among children (29). This scale consists of 5 parts including face, legs, activity, crying, and consolability. A score of 0-2 is assigned to each section. Higher scores indicate larger responses to pain. The score of each section is recorded separately and then added to calculate the total pain score. The possible score range is 0-3 (mild pain), 4-7 (moderate pain) and 8-10 (severe pain). The researcher records this scale by observing the child's behavior during anesthetic injection. FLACC is a standard tool and its validity and reliability have been confirmed by several studies (30, 31). In a study on the validity and reliability of FLACC scale, Rahaf Dak Albab et al. reported Cronbach's alpha and kappa coefficients of 0.809 and 0.952, respectively (32).

b) Wong Baker Faces Scale

Wong Baker Faces Scale was developed by Wong and Baker and recommended for children 3 years and older. This scale requires health care professionals to point to each face and describe the severity of the pain associated with it. They then ask the child to choose a face that describes his or her pain level more accurately (33). This scale represents 6 faces with increasing pain intensity from left to right. Each face ia indicates a pain score ranging from 0 to 10. Children are asked to choose a face that best reflects their pain. Children will be taught that each face indicates that they had no pain at all, or had little or severe pain. Faces 0,2, 4, 6, 8, and 10 indicates no pain, little pain, a little more pain, more pain, a lot of pain, and very severe pain (34). The validity and

reliability of this instrument have been confirmed (35).

The children in both experimental and control groups were observed from the beginning to the end of dental procedure and the findings were recorded in the pain scale. The FLACC scale was used to determine the pain severity during anesthesia injection based on the child's behavioral responses. The Wong-Baker Face Pain Scale was also used to assess children's response to pain.

The collected data was analyzed using the central and dispersion indices (mean± standard deviation), appropriate tables and charts, independent t-test, chi square, Mann-Whitney and Kruskal-Wallis tests in SPSS ver. 16. (P<0.05).

3- RESULTS

In this study, 60 children, including 33 girls and 27 boys, were randomly divided into two groups: control and experimental groups. Chi-square test was used to explore the relationship between age and sex variables with the control and experimental groups. The results showed no significant relationship between the age variable and the study group (control and experimental). There was also no statistically significant relationship between sex and the study group.

Mann-Whitney test was used to evaluate the rate of behavioral pain assessment (FLACC) between the two control and experimental groups. The results of this test showed a statistically significant difference between the control and experimental groups in this regard (P= 0.0013). That is, the mean pain score in the experimental group (1.1 ± 10.18) was lower than the control group (2.2 ± 86.24) (**Fig. 2**).

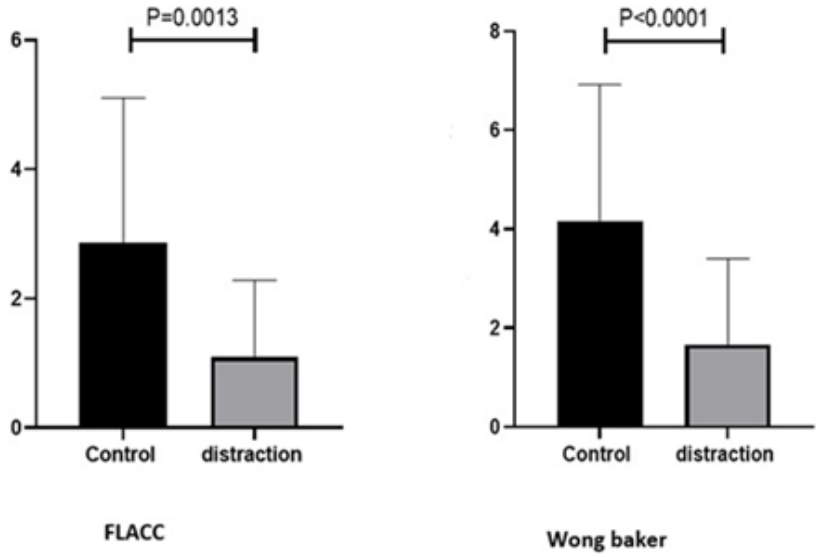

Fig. 2: Results of pain assessment by FLACC and Won baker scales in the experimental and control groups

The Wong Baker self-rating scale also showed a statistically significant difference between the control and experimental groups in terms of the mean pain score (P<0.0001). That is, the pain score in the distraction group (1.1 ± 67.82) was lower than the control group (4.62 ± 2.82) (**Fig. 2**).

The results of Mann-Whitney test (**Fig. 3**) also revealed a statistically significant

difference between the girls and the boys of the control group in terms of the rate of behavioral pain assessment (P = 0.021). The mean behavioral pain score in girls (2.2 ± 12.26) was less than boys (3.1 ± 85.86). However, there was no statistically significant difference between the boys and girls of the experimental group in terms of the behavioral pain scores (1.14 ± 1.02, 1.1 ± 06.34 respectively) (P= 0.645).

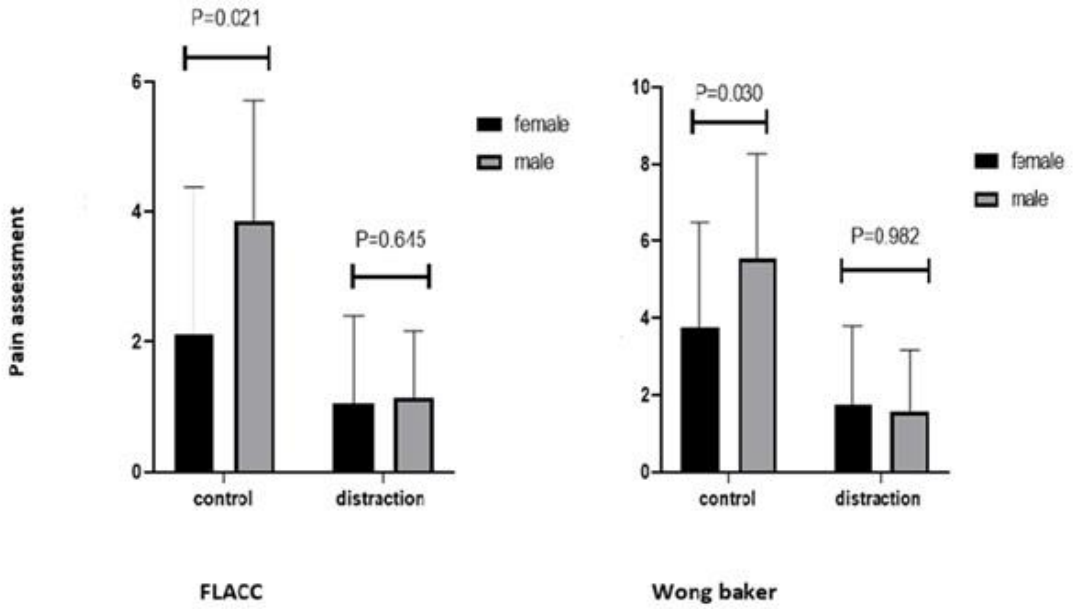

Fig. 3: Results of pain assessment by FLACC and Won baker scales in the two genders

The results of Mann-Whitney test (**Fig. 3**) showed a statistically significant difference between the girls and boys of the control group in terms of the pain self-assessment rate (P = 0.030). That is, the behavioral pain in girls (3.2 ± 76.72) was less than that in boys (5.2 ±54.72). However, there was no statistically significant difference in terms of the behavioral pain scores between the boys (1.57 ± 1.60) and girls (1.2 ± .04) of the experimental group (P = 0.982).

The results of the Kruskal-Wallis test (**Table 1**) showed no statistically significant difference between the age groups in the control group in terms of the FLACC behavioral pain assessment scores (P = 0.140). The results of this test also revealed no statistically significant difference between the age groups in the experimental group in terms of the FLACC self-assessed score of behavioral pain (P = 0.881).

Similarly, the results of Kruskal-Wallis test (**Table 1**) showed no statistically significant difference between the age groups in the control group in terms of the Wong Baker self-rating scale (P=0.268). The results of this test also showed no statistically significant difference between the age groups in the experimental group in terms of the Wong Baker self-rating scale (P=0.315).

4- DISCUSSION

Creating good memories for children during dental visits is one of the most important goals of pediatric dentistry. Anxiety and fear-related behaviors induced by dental injections are undoubtedly one of the most challenging aspects of pediatric

dentistry. Local anesthesia of the teeth is the main factor in controlling pain during the dental process (36-38).

Video games are offered on various devices from the past to the present. Considering the rapid advancement of technology, each generation is more in touch with the technology of its time. One of the most important features that these devices should have is that they should be easily accessible, cost effective and known to children in different age groups and socio-economic classes. The use of technology distractions to reduce pain has long been studied. Corah et al. (1979) used a Ping Pong video game that could be played by joysticks (39). Patel et al. (2005) used handheld game consoles (28). Kaheni et al. (2015) also used video games on portable monitors (26). All of these studies demonstrate the positive effects of video games on reducing pain during medical procedures. Patel et al. (2005) (28) showed that children who enjoyed handheld video games, compared to children who had only their parents by their side experienced less pain and anxiety during the anesthesia injection, which was consistent with the results of the present study. However, they used different tools to measure pain intensity and the age range of the study population was also different.

Table-1: Comparison of FLACC and Wong baker behavioral pain assessment scores between different age groups in thr control and experimental groups

Variables		FLACC		Wong baker	
		Control Group	Interventional Group	Control Group	Interventional Group
		N (%) or Mean(SD)	N (%) or Mean(SD)	N (%) or Mean(SD)	N (%) or Mean(SD)
Age	6 years	11 (14/32)	17 (16.53)	11(11/91)	17(17/41)
	7 years	11(16/91)	4(15/00)	11(17/71)	4(13/88)
	8 years	3(16/50)	5(19/50)	3(19/00)	5(16/10)
	9 years	5(14/40)	4(6/63)	5(16/30)	4(8/25)
Test statistics		0/665	5/484	3/549	3/943
Degrees of freedom		3	3	3	3
P- value		0/881	0/140	0/315	0/268

Video games create an active distraction effect. Allani et al. (40) investigated the effect of two types of distraction including the use of mobile phone video games (active distraction) and watching a movie (passive distraction) on pain management during dental procedures. They showed the superiority of video games in creating distraction and ultimately pain management.

Another active distraction technique is the use of virtual reality systems. Virtual reality immersion has been shown to be much more effective than conventional audio-visual systems because it distances the sense of hearing and sight from the environment (41). Aminabadi et al. (8) and Nuvvula et al. (42) also confirmed the effect of virtual reality systems on pain control in children; however, Sullivan et al. (43) did not confirm this positive effect and the results were not statistically significant.

Contrary to the popular belief, the results of the Dahlquist's study (12) showed no significant difference between the virtual reality system and computer video games in terms of their distraction outcomes.

In the present study, FLACC and Wong Baker pain instruments were applied. In a study on the effects of video game distractions during changing the dressing of the burn area in children aged 3 to 6 years, Kaheni (26) showed a significant reduction in the perception of pain. They also used the FLACC scale to measure pain. The mean FLACC pain score in the experimental group of the present study (1.18 ± 1.10) was lower than that in Kaheni's study (1.2 ± 708.575). This difference may be due to the fact that the dressing change in burning cases is much more painful than the inferior alveolar nerve block anesthesia injection. Moreover, the children studied in the Kaheni's study belonged to a lower age range.

In a study of dental anxiety and hemodynamic changes during dental procedures, Shah et al. (44) used smartphone video games, and assessed children's anxiety and pain. Their results were consistent with those of the present study confirming the positive impact of using mobile phone video games. The results of this study also showed a significant reduction in anxiety among girls as compared to boys. In the present study, there was no significant difference between girls and boys in terms of the pain intensity. This difference can be due to the different age ranges of people in the two studies.

In another study evaluating the effects of audio-visual systems as one of the distraction techniques on children's behavior during dental procedures, Amal Khotani et al. (23) reported that although the girls in the experimental group seemed to have higher anxiety levels, there was no statistically significant difference between the girls and the boys. Many other studies have also shown no significant difference between girls and boys in terms of pain perception (8, 45, 46).

The results of the present study showed no significant difference between different age groups in terms of pain scores. Numerous studies have confirmed this similarity in pain control between different age groups of children (19, 24), although the age ranges investigated in these studies are not the same as that of the present study.

One of the disadvantages mentioned for observational pain assessment scales, including the FLACC scale, is that behavioral pain reactions are the ones we observe, while pain is what the patient feels, and these items are not always related (47). Also, sometimes the same scores for different cases on this scale do not show the same pain intensity. For example, crying out loud during injection (Crying) and raising the leg (Leg) both scored 2, but don't show equal pain scores. For this purpose, in the present study, Wong Baker scale, which is a self-assessment pain scale, was also used; and both scales showed that video games have a significant effect on reducing pain during dental procedures among children. In the present study, mobile phone video games were used. Compared to virtual reality systems, mobile video games are accessible, inexpensive, portable, popular and known by a wide age range of children in different socioeconomic groups.

4-1. Ethical Considerations

The study received permission from the Ethics Committee of Mazandaran University of Medical Sciences (Ethics Code IR.MAZUMS.REC.1399.7892), and it was registered in the Iranian Registry of Clinical Trials (IRCT20201124049479N1). The samples were selected from eligible children. Before the intervention, the researcher introduced him / herself to the families of the participants and also explained the objectives of the study. Written consent forms were obtained from the parents and the children with 7 years of age and older.

In the case of under-7 children, written consent was obtained from the parents.

5- CONCLUSION

The results of the current study showed that using video games for pain distraction during the inferior alveolar nerve block injection is significantly effective in reducing pain among children aged 6-9 years. The results of both the FLACC (P = 0.0013) and the Wong Baker Pain Self-Assessment Scale (P <0.0001) confirmed this statement. Therefore, it may be advisable to use video games to create pain distraction during the inferior alveolar nerve block injection as a method for reducing pain and suffering, which can by itself help increasing the mental health and, for sure, oral health for pediatric patients.

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