Original Article

The Effect of an Audiovisual Distraction Method on 6-10-Years Old Children's Behavior During Dental Treatment: A Clinical Trial

Przha K. Muhammed[1], Arass J. Noori[1]*

Abstract

Objective: Management of uncooperative and anxious children during dental treatment is a major problem in pediatric dentistry. This study was designed to assess the effect of an audiovisual distraction method in minimizing the fear and anxiety of the child patient during dental treatment.

Methods: A randomized clinical trial with a parallel design was carried out on 40 children aged between 6 and 10 years to ascertain the efficacy of the audiovisual (virtual reality eyeglasses) distraction method in reducing children's dental anxiety during local anesthetic administration. Forty children were randomly divided into two groups; the control group (conventional local anesthesia injection alone) and the study group (conventional local anesthesia injection combined with audio-visual virtual reality eyeglasses). The pain experience and anxiety were assessed using a combination of measures: visual analog scale (child self-report) & visual analog scale (parent report), pulse rate and oxygen saturation SpO2 (physiological), and behavior assessment performed using (Frankl's behavior rating scale and Houpt's scale).

Results: All 40 children completed the study. A highly significant reduction in the child's anxiety and pain experienced in the audiovisual distraction group was seen as reported by the visual analog scale ($p < 0.001$) and Houpt scale ($p < 0.003$). In contrast, pulse rate and spo2 showed no statistically significant difference between the two groups.

Conclusions: Audiovisual distraction method offers an effective distraction tool for alleviating the pain and unpleasantness that arises while administering local anesthesia in dental treatment.

Keywords: *Audiovisual distraction, Children's anxiety, Behavior guidance.*

Submitted: July 4, 2022, Accepted: September 20, 2022, Published: December 1, 2022.

Cite this article as: Muhammed PK, Noori AJ. The Effect of an Audiovisual Distraction Method on 6-10-Years Old Children's Behavior During Dental Treatment: A Clinical Trial. Sulaimani Dent J. 2022;9(2):47-52.

DOI: https://doi.org/10.17656/sdj.10157

1. Pedodontics, Orthodontics and Preventive Dentistry Department, College of Dentistry, Sulaimani University, Sulaimani, Iraq.

** Corresponding author: Prwsha.k.muhaa@gmail.com.*

Published by College of Dentistry, University of Sulaimani

Introduction

One of the major problems in pediatric dentistry relates to the management of uncooperative and anxious children during treatment. Dental fear and anxiety (DFA), which indicates strong negative emotions associated with dental treatment among children and adolescents, is the most common cause of behavioral management problems and the non-compliance of children during treatment. The prevalence of DFA in children was reported to be 5–20%[1].

The key skill that all dentists need is the ability to perform safe and effective local anesthesia (LA). Unfortunately, LA injections are probably the patient's biggest source of anxiety, and dentists' inability to achieve adequate pain control with minimal discomfort is a major concern[2].

Hence a primary goal of a pediatric dentist is to provide a positive experience for a child in dental surgery. To accomplish this, various behavior guidance techniques are used, including distraction, diverting the child's attention away from what may appear to be an unpleasant procedure[3]. The premise underlying its efficacy is to reduce a child's ability to pay attention to unpleasant stimuli in the dental office while diverting their attention to engrossing and exciting distractions[4,5].

Furthermore, distraction can be active or passive; active forms encourage a child's participation by incorporating several sensory components such as interactive toys, virtual reality, controlled breathing, guided imagery, and relaxation[6-9]. Conversely, passive forms induce distraction through a child's observation of activity or stimulation rather than their active participation, such as listening to music or watching television[10-12]. Hence, this study was carried out to compare the effectiveness of a new approach, the virtual reality video eyeglasses when combined with conventional LA against conventional LA injection alone during dental treatment.

Patients and methods

The Scientific and Ethical Committee approved the study protocol of the College of Dentistry (Scientific committee approval; No. 494 on 3/11/2022 and Ethical committee for research approval: No. 56/21 on 3/11/2021). Accordingly, a randomized clinical trial with a parallel design was carried out on 40 children aged between 6 and 10 years; the children were randomly divided into two groups; the control group (conventional LA injection alone), the study group (conventional LA injection combined with audio-visual virtual reality eyeglasses). The participants were selected from children attending a private clinic and the post-graduate clinics of the College of Dentistry at the University of Sulaimani based on the following eligibility criteria for the children:

1. No learning disability.
2. No previous psychological trauma.
3. Absence of any systemic disease.
4. Absence of any physical and mental disabilities.

Virtual reality eyeglasses

Audiovisual video glasses (virtual reality, VR) refer to a human-computer interface that allows users to interact dynamically with the computing environment (figure 1). Unlike less sophisticated audiovisual distraction, VR (virtual reality) uses sophisticated systems such as a wide-field head mount, 3D displays (HMDs), and motion detection systems that measure the position of the user's head and hands[13]. Such a system can trump traditional distraction because it allows for more immersive images by projecting images in front of the user's eyes and using real-world blocking (visual, auditory, or both) impulses depending on the model used[14].

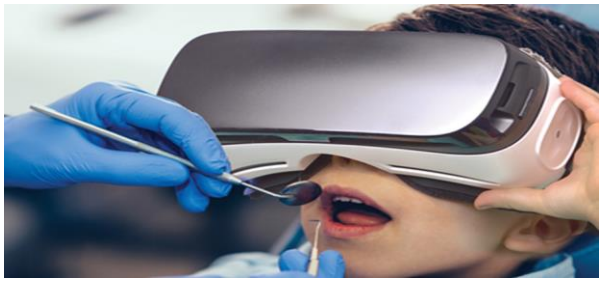

Figure 1: virtual reality eyeglasses wore by child during dental treatment.

VAS, as used in the present study

The visual analog scale is the most applicable for assessing children[15]. The Visual analog scales (VAS) are psychometric measuring instruments developed to capture the characteristics of disease-related symptom severity in individual patients and pain intensity[16].

Behavioral and physiological measures used in the present study

Each child was assigned a Frankl behavior rating score before starting the treatment[17]. The researcher assigned a Houpt behavior rating score after treatment[18]. The Oxygen saturation (SpO2) and heartbeat rate were measured before, during, and after dental treatment.

Intervention

The pre-operative behavior evaluation of all the recruited children was recorded 10 minutes before the intervention, using a Frankl behavior rating scale, after which local anesthesia was administered (buccal, labial, or/and palatal infiltration or inferior alveolar nerve block) following the standard protocol[19], by a single investigator. The children in group I received conventional LA with routine behavior guidance method (control). In the study group, local anesthesia was received combined with audiovisual distraction (AVD) with virtual reality eyeglasses (figure 1). Each child's behavior during the oral examination and dental procedure was rated using the Houpt scale[18]. All the variations in the pulse rate and SpO2 (physiological measure) 10 minutes before starting the procedure, during injection of LA, and post-injection period (1 min after removal of the needle from the tissue) were recorded using a fingertip pulse oximeter. An investigator not involved in the treatment procedure (RC) recorded all the observational and physiological measures. Before starting the dental procedure, the opinion of children about the LA administration was evaluated by an investigator who was ‘‘blinded’’ to randomization (SN) using a structured face-to-face, closed, fixed-response interview, a component of which was the discomfort experienced by the children as expressed in (VAS)[20]. parent satisfaction was also recorded after treatment using a visual analog scale.

Sample size and randomization

A pilot study was performed on ten children (5 in each group), with the level of significance set at 0.05, a power of 80 %, and considering the effect size and self-report scores of VAS as a primary outcome measure, a sample size of 40 (20 in each group) was essential and an inclusion period of 6 months to recruit this number of patients. Restricted randomization or block randomization was used in the study with random block sizes of 4 and 6. A table of random numbers was used to generate the random allocation sequence.

Statistical methods

The statistical analysis was carried out using IBM's standard statistical package (SPSS-V22). The normality of data was analyzed using a Shapiro– Wilk test. The intergroup comparisons of the Frankl scale, Houpt scale, VAS, and physiologic measure were made in all the treatment groups using the Mann-Whitney test. A cut-off level of significance was set at 5% for all the statistical analyses.

Results

The enrollment, randomization, allocation, and completion of children in different groups are represented in the consort flow diagram (Figure 2).

The normality test analysis showed that the majority of the data groups do not follow a normal distribution ($p<0.05$). The Mann-Whitney intergroup comparisons regarding the Frankl behavior scale showed no statistically significant difference between the two groups ($p>0.05$). In contrast, the Intergroup comparison of the Houpt scale (observational measure) showed a statistically significant result ($p=0.023$). Furthermore, the Mann-Whitney inter-group comparison of VAS (self-report measure) showed a significant result in the distraction group for both child and parent, which was statistically significant ($p<0.005$) (Table 1). The two groups' intergroup comparisons of physiological measures showed no significant result before, during, and after the treatment (Table 1).

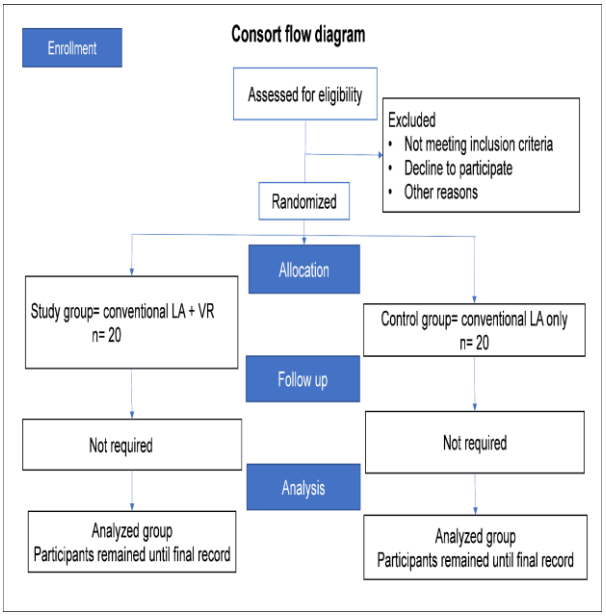

Figure 2: Consort flow diagram of recruitment, randomization, allocation, and completion of children experiencing local anesthetic administration.

Discussion

Dental treatments, particularly LA administration, often cause anxiety and distress in children, leading to increased pain reactivity. As a result, it's critical to apply specialized interventions to distract their attention from the operatory procedure. As a result, this clinical trial experiment was conducted to determine the

efficacy of 3D video glasses in reducing children's fear and anxiety. The VAS was selected for this research because it is a reliable and valid measure of anxiety and pain assessment in children[21]. In addition, effective pain management is crucial to increase patient compliance in the dental operatory[22].

Anxiety and fear of unfamiliar situations cause children to view dental procedures as difficult, and exposure to other children and relatives who have had negative dental experiences exacerbates dental fear in children. Avoiding dental treatment due to anxiety and fear exacerbates problems

Table 1: The Mann-Whitney test results and Mean Rank for both groups.

Behavior Management Type	Test groups	N	Mean Rank	Mann–Whitney U test		
				U	z	p
Frankle Scale	Conventional LA only	20	19.125	172.5	-1.02486	0.461
	Conventional + VR	20	21.875			
Houpt Scale	Conventional LA only	20	16.325	116.5	-2.42303	0.023*
	Conventional + VR	20	24.675			
VAS (Child)	Conventional LA only	20	27.4	62	-3.78329	0.000*
	Conventional + VR	20	13.6			
VAS (Parent)	Conventional LA only	20	29.075	28.5	-4.71626	0.000*
	Conventional + VR	20	11.925			
SPO2 before	Conventional LA only	20	22.7	156	-1.28012	0.242
	Conventional + VR	20	18.3			
HR before	Conventional LA only	20	20.025	190.5	-0.25742	0.799
	Conventional + VR	20	20.975			
SPO2 during	Conventional LA only	20	20.35	197	-0.08501	0.947
	Conventional + VR	20	20.65			
HR during	Conventional LA only	20	18.35	157	-1.16436	0.253
	Conventional + VR	20	22.65			
SPO2 after	Conventional LA only	20	22.35	163	-1.02879	0.327
	Conventional + VR	20	18.65			
HR after	Conventional LA only	20	20.65	197	-0.08215	0.947
	Conventional + VR	20	20.35			

* Significance level is 0.05.

related to the patient's oral health. Further, treating anxious patients tends to be more difficult and time-consuming[23].

In this study, two groups were selected for the analysis, one for conventional local anesthesia injection alone and another one for the combination of conventional LA with virtual reality eyeglasses distraction method, to estimate the effect of the VR eyeglasses distraction on the local anesthesia experience for the child patient during injection and also to estimate the satisfaction of the parent regarding the dental procedure. The result showed a non-significant difference between the two groups regarding the Frankl behavior scale, which is important as the starting point in these studies. Frankl's behavior scale measures the pre-operative behavior status of the subject patients, and the baseline behavior status of all participants should not be statistically significant for other measurement comparisons to be correctly applied.

The Houpt scale assessed the cooperation of the children during the operative procedure, and significant improvements were shown through the application of the VR eyeglasses with the conventional LA in accordance with previous reports that distraction methods through VR eyeglasses can provide a very useful tool to prepare a child patient for a dental procedure[24,25].

After the injection of the local anesthesia, the VAS score was recorded immediately, which was used to assess the child's experience with the LA injection. The statistical analysis showed significantly higher results for the child's pain experience after injection, with a higher mean score regarding the conventional LA group alone, showing higher pain and less favorable experience regarding the conventional LA injection group alone. Furthermore, this result also showed that the distraction method could provide a very useful tool for alleviating pain experience and elevating the pain threshold level, demonstrating the positive effect of distraction methods during dental procedures.

Further analysis was performed on the parent to assess their satisfaction with the procedure through the VAS scale, again the result showed a higher mean score for the parent regarding the conventional LA group with VR; this result showed that the parents were more comfortable and satisfied regarding their child's more engagement and cooperation for the dental procedure with distraction method. For all of the variables studied,

there was no difference in anxiety between males and females. Although gender may not predict dental anxiety, it may interact with other factors to predispose children to the problem[26].

The vital signs were recorded using (a fingertip device) before, immediately after injection and after treatment; further investigation regarding the vital signs showed no significant differences between the two groups. This may be due to the fact that the LA may not affect this short-term procedure. However, elevated heart rate and blood pressure during the delivery of LA were reported in one study[27], whereas an increase in pulse rate during dental treatment procedures was noted in another two studies[28,29].

In the current investigation, using 3D video glasses as a distraction was clinically practical, safe, and did not require any prior training for the clinician; however, there were several limitations, including the lack of eyeglasses for children with small faces or heads. Other issues noted were headaches, nausea, and difficulty communicating with the children[24]. Also, A major limitation of the present study was the inability to plan for a split-mouth design because of the time limitation.

Conclusion

High satisfaction, pain alleviation, and cooperation levels were observed among children who used virtual reality video glasses during a dental procedure. This method of distraction may enhance the positive attitude toward children's dental experience and play a pivotal role in alleviating mild to moderate dental anxiety in children.

References

1. Klingberg G, Broberg AG. Dental fear/anxiety and dental behavior management problems in children and adolescents: a review of prevalence and concomitant psychological factors. Int J Paediatr Dent. 2007;17(6):391-406.
2. Felemban OM, Alshamrani RM, Aljeddawi DH, Bagher SM. Effect of virtual reality distraction on pain and anxiety during infiltration anesthesia in pediatric patients: a randomized clinical trial. BMC Oral Health. 2021;21(1):1-10.
3. American Academy of Pediatric Dentistry. Behavior guidance for the pediatric dental patient. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry. 2021:306-24.
4. Lambert SA. Distraction, imagery, and hypnosis. Techniques for management of children's pain. J Child Fam Nurs. 1999;2(1):5-15.
5. Klieber C, McCarthy AM. Evaluating instruments for a study on children's responses to a painful procedure when parents are distraction coaches. J Pediatr Nurs. 2006;21(2):99-107.
6. Peretz B, Gluck GM. Assessing an active distracting technique for local anesthetic injection in pediatric dental patients: repeated deep breathing and blowing out air. J Clin Pediatr Dent. 1999;24(1):5-8.
7. Patel A, Schieble T, Davidson M, Tran MCJ, Schoenberg C, Delphin E, et al. Distraction with a hand-held video game reduces pediatric pre-operative anxiety. Paediatr Anaesth. 2006;16(10):1019-27.
8. Weydert JA, Shapiro DE, Acra SA, Monheim CJ, Chambers AS, Ball TM. Evaluation of guided imagery as treatment for recurrent abdominal pain in children: a randomized controlled trial. BMC Pediatr. 2006;6(1):1-10.
9. Nilsson S, Finnström B, Kokinsky E, Enskär K. The use of Virtual Reality for needle-related procedural pain and distress in children and adolescents in a paediatric oncology unit. Eur J Oncol Nurs. 2009;13(2):102-9.
10. Aitken JC, Wilson S, Coury D, Moursi AM. The effect of music distraction on pain, anxiety and behavior in pediatric dental patients. Pediatr Dent. 2002;24(2):114-8.
11. Marwah N, Prabhakar AR, Raju OS. Music distraction - its efficacy in management of anxious pediatric dental patients. J Indian Soc Pedod Prev De. 2005;23(4):168-70.
12. Prabhakar AR, Marwah N, Raju OS. A comparison between audio and audiovisual distraction techniques in managing anxious pediatric dental patients. J Indian Soc Pedod Prev Dent. 2007;25(4):177-82.
13. Lier EJ, Harder J, Oosterman JM, Vries M de, Goor H van. Modulation of tactile perception by Virtual Reality distraction: The role of individual and VR-related factors. PLOS ONE. Public Library of Science. 2018;13(12):1-10.
14. Wismeijer AAJ, Vingerhoets AJJM. The use of virtual reality and audiovisual eyeglass systems as adjunct analgesic techniques: a review of the literature. Ann Behav Med. 2005;30(3):268-78.
15. Alinejhad D, Bahrololoomi Z, Navabazam A, Asayesh MA. Comparison of visual analog scale scores in pain assessment during pulpotomy using

different injection materials in children aged 6 to 8 and 8 to 10 years. J Contemp Dent Pract. 2018;19(3):313-7.
16. Klimek L, Bergmann K-C, Biedermann T, Bousquet J, Hellings P, Jung K, et al. Visual analogue scales (VAS): Measuring instruments for the documentation of symptoms and therapy monitoring in cases of allergic rhinitis in everyday health care. Allergo J Int. 2017;26(1):16-24.
17. Riba H, Al-Zahrani S, Al-Buqmi N, Al-Jundi A. EC dental science review article a review of behavior evaluation scales in pediatric dentistry and suggested modification to the frankl scale. 2018;18:1-7.
18. Hosey MT, Blinkhorn AS. An evaluation of four methods of assessing the behaviour of anxious child dental patients. Int J Paediatr Dent. 1995;5(2):87-95.
19. Reed KL, Malamed SF, Fonner AM. Local anesthesia part 2: technical considerations. Anesth Prog. 2012;59(3):127-36.
20. McGrath PA. Evaluating a child's pain. J Pain Symptom Manage. 1989;4(4):198-214.
21. Luyk NH, Beck FM, Weaver JM. A visual analogue scale in the assessment of dental anxiety. Anesth Prog. 1988;35(3):121-3.
22. Alshatrat SM, Sabarini JM, Hammouri HM, Al-Bakri IA, Al-Omari WM. Effect of immersive virtual reality on pain in different dental procedures in children: A pilot study. Int J Paediatr Dent. 2022;32(2):264-272.
23. Shim Y-S, Kim A-H, Jeon E-Y, An S-Y. Dental fear & anxiety and dental pain in children and adolescents; a systemic review. J Dent Anesth Pain Med. 2015;15(2):53-61.
24. Nuvvula S, Alahari S, Kamatham R, Challa RR. Effect of audiovisual distraction with 3D video glasses on dental anxiety of children experiencing administration of local analgesia: a randomised clinical trial. Eur Arch Paediatr Dent. 2015;16(1):43-50.
25. Ram D, Shapira J, Holan G, Magora F, Cohen S, Davidovich E. Audiovisual video eyeglass distraction during dental treatment in children. Quintessence Int. 2010;41(8):673-9.
26. El-Sharkawi HFA, El-Housseiny AA, Aly AM. Effectiveness of new distraction technique on pain associated with injection of local anesthesia for children. Pediatr Dent. 2012;34(2):e35-38.
27. Liau FL, Kok S-H, Lee J-J, Kuo R-C, Hwang C-R, Yang P-J, et al. Cardiovascular influence of dental anxiety during local anesthesia for tooth extraction. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008;105(1):16-26.
28. Simpson WJ, Ruzicka RL, Thomas NR. Physiologic responses of children to initial dental experience. ASDC J Dent Child. 1974;41(6):465-70.
29. West GA, Reid KH, Bastawi AE. Autonomic responses to dental procedures in pedodontic patients during a standard restoration session. J Dent Res. 1983;62(6):728-32.