



ORIGINAL RESEARCH PAPER

Dental Science

EFFECT OF VIRTUAL REALITY HEADSET USING SMART PHONE DEVICE ON PAIN AND ANXIETY LEVELS DURING LOCAL ANESTHETIC INJECTION IN CHILDREN WITH 6-10 YEARS OF AGE

KEY WORDS: Virtual Reality Headset, Anxiety, Pain, Distraction technique, Local anesthetic injection

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ABSTRACT	Aim To evaluate the effect of Virtual Reality Headset (VRH) using smart phone device on pain and anxiety levels during local anesthetic injection in children with 6-10 years of age.
	Materials and methods Study design: Sixty children with bilateral carious molars were equally divided into 2 groups (Group I: 6-8 years & Group II: 8-10 years) .The groups were further subdivided into Local Anesthetic(LA) injection with Virtual Reality Headset(VRH) and Local Anesthetic(LA) injection without Virtual Reality Headset(VRH). Pain and anxiety levels were measured &statistically analyzed using Mann Whitney U test and Student t-t-test.
	Results Highly significant difference was observed in pain level in 6-8 years (Group I) children with VRH and without VRH. However, on comparison of anxiety levels ,no significant difference was observed in the same group. In children of age 8-10 years (Group II) on comparison of pain level in children with VRH and without VRH, highly significant difference was observed. Significant difference was observed in anxiety level of same group.
	Conclusion VRH with smart phone device has successfully reduced pain and anxiety levels in both 6-8 years and 8-10 years old children. However, VRH is more effective in reducing anxiety and pain level in older age group (8-10 years).

INTRODUCTION

A pediatric dentist is expected to treat childhood dental diseases effectively that are within the knowledge and skills acquired during their professional education. Understanding and efficiently treat the diseases most of the time requires modifying the child's behavior .

Every child is different and they exhibit a broad range of physical, intellectual, emotional, and social development and a diversity of attitudes and temperament. Therefore, it is important that pediatric dentists have knowledge of a wide range of behavior guidance techniques to meet the needs of the individual child¹.

Anxiety is an uncomfortable psychological state concerning impending or anticipated illness. Dental anxiety denotes a state of nervousness in relation to dental treatment. Various methods of reducing patient anxiety have been used in dentistry. One of them is distraction².

Audiovisual distraction technique is one of the behavior modification techniques which is based on passively distracting two types of sensations—hearing and seeing³. Several investigators have probed the efficacy of audiovisual distraction in decreasing child's stress during medical procedures such as immunization⁴, venipuncture⁵ and during dental treatment⁶. The use of virtual reality (VR) as a distraction tool is developing attention in medical and dental field⁷. Hence the present study, was carried out to judge the effectiveness Virtual Reality Headset on pain and anxiety levels during local anesthetic injection in children with 6-10 years of age.

MATERIALS AND METHODS

The present study was conducted in Department of Pedodontics and Preventive Dentistry in People's Dental Academy, Bhopal. The study protocol was approved by the ethical committee. Informed consent was received from all parents/guardians The duration of the study was 6 months and the sample collection was conducted during the Department's OPD timings by simple random sampling method.

Study design

This was a split-mouth cross-over randomized control trial. Both

the genders were included. Subjects were divided into two groups according to their age (Group I: 6-8 years, Group II: 8-10 years) (Figure 1). Frankl scale⁸ was used. Selected subjects were rated a positive behavior (Frankl scale 3 or 4) during the recruitment visit. Every child during LA injection, was subjected to VRH and without VRH, at first and second visit consecutively. Treatment was done in two visits 1 to 4 weeks apart. Only one pediatric dentist performed all dental treatments following the standard protocol in both the visits. The recordings were done using Nikon Coolpix L28 camera. During dental treatment, dentist explained about the procedure using tell-show-do technique. Pulse rate was measured using pulse oximeter. An introduction to Virtual Reality Headset with a choice of five cartoon movies and songs was presented to the subjects. They were given few minutes to get accustomed to the VR Headset (Figure 2). In the second visit without using VR Headset, other behavior management techniques were used which were tell-show-do, positive reinforcement and conventional distraction methods like breath counting, counting one to hundred was used.

Assessment of Anxiety

Assessment of anxiety was done by Venham Picture Test⁹ (Figure 3).

Assessment of Pain

Assessment of Pain was done using Wong Baker's Faces Pain Rating Scale¹⁰(Figure 4) and FLACC^{11,12,13} Scale (Figure 5).

Assessment of Physiological Parameters

Pulse Rate and Oxygen Saturation level was measured with the help of Finger Pulse Oximeter (NL-50D)

STATISTICAL ANALYSIS

The data obtained was subjected to Statistical analysis using Statistical package of Social Sciences (SPSS Version 20; Chicago Inc, USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Mann-Whitney test Kolmogorov-Smirnov and Shapiro-Wilk test. Student t-test are applied. All statistical tests were at 95% level of confidence and the significant level was fixed at P≤0.05.

RESULTS

Seventy-one participants were enrolled in the present study. Five participants refused to wear Virtual Reality Headset, four were unable to rate their behavior, and two children failed to return for a second visit. A total of sixty participants were included in the study group, aged 6-8 years and 8-10 years.

Anxiety assessment

Mean anxiety level was significantly high in group I study subjects as compared to group II. There was statistically no significant difference in anxiety level by Venham Picture Test among subgroup IA & IB study subjects. (p=0.408). There was statistically highly significant difference in anxiety level by Venham Picture Test among subgroup IIA & IIB study subjects. (Table 1)

Pain assessment

Wong-Baker's Faces Pain Rating Scale
There was statistically highly significant difference in pain score among group I & II study subjects. There was statistically highly significant difference in pain score among subgroup IA & IB study subjects. Comparison of pain by Wong-Baker's Faces Pain Rating Scale (WBFRS) among subgroup IA & IB study subjects. There was statistically highly significant difference in pain score among subgroup IIA & IIB study subjects. (Table 2)

FLACC Scale

Mean pain score was significantly high among group I study subjects as compared to group II.

There was statistically highly significant difference in pain score among group I & II study subjects. subgroup IA & IB study subjects. Comparison of subgroup IIA & IIB study subjects. Comparison of There was statistically highly significant difference in pain score among subgroup IA & IB & subgroup IIA & IIB study subjects. (Table 3)

Pulse Rate and Oxygen Saturation levels

Mean pulse rate was significantly high among group I study subjects as compared to group II. There was statistically no significant difference in mean pulse rate among subgroup IA & IB study & IIA & IIB study subjects. (Table 4)

- Mean Oxygen Saturation Level (Spo2%) was less among group I study subjects as compared to group II
- There was statistically no significant difference in mean pulse rate among group I & II study subjects &
- subgroup IA & IB & subgroup IIA & IIB study subjects (Table 5)

Table 1- Mean, SD, Median, Range and Mann Whitney U Test for Venham Picture Test in Group and Subgroups measured in the study

Variable	Group	Mean	SD	Median	Range	Test Value	P-Value
Venham Picture Test	I (6-8yrs)	3.73	1.202	3.50	2-7	295.500	0.016(S)
	II (8-10yrs)	2.97	0.999	3.00	1-5		
	IA (6-8yrs L.A with VRH)	3.60	1.242	3.00	2-6	93.500	0.408(NS)
	IB (6-8yrs L.A without VRH)	3.87	1.187	4.00	2-7		
	IIA (8-10 yrs L.A with VRH)	2.40	0.986	2.00	1-5	34.500	0.001(HS)
	IIB (8-10 yrs L.A without VRH)	3.53	0.640	3.00	3-5		

Table 2- Mean, SD, Median, Range and Mann Whitney U Test for Wong Baker's Faces Pain Rating Scale in Group and Subgroups measured in the study.

Variable	Group	Mean	SD	Median	Range	Test Value	P-Value
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Wong-Baker's Faces Pain Rating Scale (WBFRS)	I (6-8yrs)	4.27	1.461	4.00	2-8	132.500	0.001(HS)
	II (8-10yrs)	2.40	0.932	3.00	1-4		
	IA (6-8yrs L.A with VRH)	3.33	0.724	3.00	2-5	26.000	0.001(HS)
	IB (6-8yrs L.A without VRH)	5.20	1.424	5.00	2-8		
	IIA (8-10 yrs L.A with VRH)	1.67	0.724	2.00	1-3	13.000	0.001(HS)
IIB (8-10 yrs L.A without VRH)	3.13	0.352	3.00	3-4			

Table 3- Mean, SD, Median, Range and Mann Whitney U Test for FLACC Behavioral Pain Assessment Scale in Group and Subgroups measured in the study.

Variable	Group	Mean	SD	Median	Range	Test Value	P-Value
FLACC Behavioral Pain Assessment Scale	I (6-8yrs)	4.13	1.408	4.00	1-7	168.500	0.001(HS)
	II (8-10yrs)	2.53	1.074	3.00	1-5		
	IA (6-8yrs L.A with VRH)	3.27	1.100	3.00	1-6	28.000	0.001(HS)
	IB (6-8yrs L.A without VRH)	5.00	1.134	5.00	3-7		
	IIA (8-10 yrs L.A with VRH)	1.80	0.862	2.00	1-4	22.000	0.001(HS)
	IIB (8-10 yrs L.A without VRH)	3.27	0.704	3.00	1-5		

Table 4- Mean, SD and Student t-test for Pulse Rate in Group and Subgroups measured in the study

Variable	Group	Mean	SD	Test Value	P-Value
Pulse Rate	I (6-8yrs)	102.60	5.110	2.053	0.045(S)
	II (8-10yrs)	99.73	5.693		
	IA (6-8yrs L.A with VRH)	101.20	4.586		
	IB (6-8yrs L.A without VRH)	104.00	5.372	1.535	0.136(NS)
	IIA (8-10 yrs L.A with VRH)	99.87	6.140		
	IIB (8-10 yrs L.A without VRH)	99.60	5.422		

Table 5- Mean, SD and Student t-test for Oxygen Saturation Level(SpO2%) in Group and Subgroups measured in the study.

Variable	Group	Mean	SD	Test Value	P-Value
Oxygen Saturation Level (SpO2%)	I (6-8yrs)	94.67	2.604	0.685	0.496(S)
	II (8-10yrs)	95.13	2.675		
	IA (6-8yrs L.A with VRH)	94.27	2.576		
	IB (6-8yrs L.A without VRH)	95.07	2.658	0.837	0.410(NS)
	IIA (8-10 yrs L.A with VRH)	95.07	2.915		
	IIB (8-10 yrs L.A without VRH)	95.20	2.513		

DISCUSSION

Pediatric patients have aberrant reciprocation to the dental treatment rendered. Hence, it is extremely important to manage anxiety of children which affects dental procedures and its

outcome. Investigators have researched on mechanisms by which music has proved to decrease the anxiety. The Gate Control Theory of Pain, proposed by Ronald Melzack and Patrick Wall¹⁴, states that pain signals are transmitted from the place of injury, via nerve receptors in spinal cord, to receive pain information in brain. Music is believed to send enough competing sensory inputs from the brain to cause the brainstem to signal some of the gates shut, hence reducing the amount of pain that the patient listening to the music perceives¹⁵. Also, visual images leave great impact on our minds.

Therefore, the present study has been undertaken to evaluate the efficacy of audio-visual distraction aid. Virtual Reality Headset with smart phone device is a light weight system which has proved to be more economic, more appealing and captivating to children.

In relation to the self reported anxiety, on comparison of subgroup IA & IB, children depicted lesser anxiety with VR Headset in 6-8 year old age group but was not significant; however, VRH is found to be highly significant in 8-10 year old children when subgroup IIA & IIB were compared. Children were found to be more playful and relaxed. They have selected faces that looked happier when VR Headset was placed. Similar results were obtained in a study conducted in 2014¹⁶, where 79% of the sample scored zero in the VPT at the end of the visit.

Numerous self-reporting pain scales have been used in the past^{17,18}. In the present study, Wong Baker's Faces Pain Rating Scale¹⁰ was used. Highly Significant difference was noted amongst all the groups in which LA was being administered with the VRH. A difference in self-reported pain during dental treatment was observed in a study conducted by Baghdadi¹⁹. In contrast, Aitken et al. 2002²⁰ who used music with younger children (4-6 years) and Hoge et al.²¹ who used video eyeglass in children aged 4-16 years did not show any significant difference in their visits. Children in our study with 6-10 years of age were able to distinguish sensation of pain when compared to younger children described above.

The Face Leg Activity Cry Consolability (FLACC) Behaviour Pain Assessment Scale results depicted that VR Headset with smart phone device while giving LA efficiently reduced child's physical distress. Similar results were obtained in a study done by Mitrakul et al. in 2015²² but the FLACC score was not significant when compared to the present study in which the FLACC scores are highly significant.

Physiological parameters of anxiety were made by recording the pulse rate and oxygen saturation levels using the pulse oximeter. As pain & vasoconstriction can cause change in heart rate, it is inevitable to compare pulse rate which is related to the stress during the dental procedures²³. A significant difference was noted in pulse rate among Group I & II patients; whereas results were statistically insignificant when subgroup IA & IB and IIA & IIB were compared. Also, the oxygen saturation levels depicted insignificant results; which was in accordance with findings of Marwah N et al²⁴; Rayen R et al²⁵; Korhan EA et al²⁶.

In the present study, older age(8-10 years) group children showed more cooperation when compared with the younger ones. The difference might be explained by the fact that different age groups have different behavioral and cognitive actions towards the VR Headset²⁷. We suggest that the use of VRH turns out to be profitable when behavior of pediatric patient is considered as it appears fascinating to them when compared with music alone. This is in accordance with the study done by Parkin in 1981²⁸, who believed that any new or special element can improve patient behavior. In contrary to the above observations, Sullivan et al.²⁹ on the use of virtual reality concluded that negative behavior continues in children when they cannot analyze what is happening around them.

CONCLUSION

1) Virtual Reality Headset (VRH) with a smart phone device has successfully reduced anxiety and pain in children of Group I(6-

- 8) years old and Group II(8-10) years of age.
- 2) On comparison for reducing anxiety and pain utilizing VR Headset in both the groups, it was observed that VRH was more effective in older age children i.e. Group II (8-10) years of age.
- 3) Children of both the groups were happy during the dental treatment using VRH and they have showed the desire to use VRH on repeated visits.
- 4) VRH can be used as an adjunctive distraction technique leading to improved comfort and cooperation during dental treatment in children.

LEGENDS FOR THE FIGURES

Figure 1- Flow chart illustrating the division of children during local anesthetic injection with and without virtual reality headset according to their age.

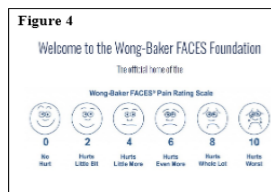
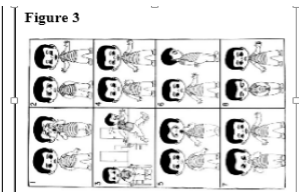
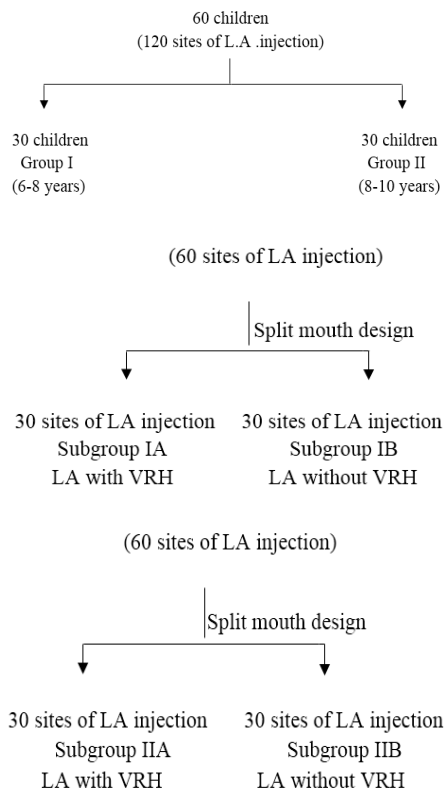
Figure 2- Photograph of child in the Virtual Reality Headset .

Figure 3- Venham Picture Test

Figure 4- Wong-Baker's Faces Pain Rating Scale

Figure 5- FLACC Behavioral Pain Assessment Scale

Figure 1 – Flow chart illustrating the division of children during local anesthetic injection with and without virtual reality headset according to their age



FLACC Behavioral Pain Assessment Scale			
OBSERVE	SCORE		
	0	1	2
Face	Relaxed, neutral	Closed, squinted	Tight shut, clenched
Eyes	Open, normal	Squinted, closed	Tight shut, clenched
Activity	Relaxed, normal	Squinted, closed	Tight shut, clenched
Cry	None	Squinted, closed	Tight shut, clenched
Consolability	Comfortable	Squinted, closed	Tight shut, clenched

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