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Original Article

Effectiveness of behavioral modification techniques with visual distraction using intrasulcular local anesthesia in hearing disabled children during pulp therapy

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ABSTRACT

Objective: Assessing the effectiveness of behavioral modification techniques in combination with visual distraction with/without video eyewear using computerized delivery system-intrasulcular (CDS-IS) during the application of local anesthetic in hearing-impaired pediatric patients undergoing pulp therapy of primary molars. **Materials and Methods:** This randomized, crossover clinical study includes 15 children (7 boys and 8 girls), mean age was 6.1 years. Children were randomly distributed into two groups (Group A, $n = 7$; Group B, $n = 8$). The study involved three sessions, 1-week apart. During Session I, employing Tell-Show-Do technique, prophylactic dental cleaning was done while participants were watching a movie with sign-language interpretation with/without visual eyewear. At the end of Session I, score on Smiley Faces Program was used for anxiety assessment. During Session II and III, respectively, both groups underwent pulp treatment of equivalent teeth in the opposite sides of the mouth with/without video eyewear vice versa. After the procedure, children were instructed to rate their pain during treatment on the Wong-Bakers' (WBs') Faces Pain Scale. Changes in pulse oximeter and heart rate were recorded every 5 min. Paired sample *t*-test and independent sample *t*-test were used to assess the significance of changes during each visit. **Results:** There was a significant ($P > 0.04$) change in the heart rate observed for Group A underwent pulp treatment while watching video using video eyewear. Self-reported mean pain score also increases during treatment sessions' with video eyewear, for both groups. **Conclusion:** Routine psychological (Tell-Show-Do) intervention along with visual distraction with full visibility of the surrounding and use of CDS-IS system for anesthetic delivery is recommended as an effective behavior management technique for children with hearing impairment undergoing invasive dental treatment.

Key words: Computerized delivery system-intrasulcular, hearing disability, pulp therapy, visual distraction eyewear

INTRODUCTION

Hearing disability is a condition in which individual is either profoundly hearing impaired, or some have a less severe disability to detect audible frequencies. During dental treatment, they often faced communication difficulties which are a barrier to get needed care.[1,2] In addition, several research studies support the proposition that pain or fear

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of pain is a primary source of dental anxiety and a major obstacle for seeking dental care.[3,4] Children with hearing impairment are especially anxious of the unknown.[1] Such fear ranges from fear of needle to fear of bodily harm to a general fear of the unknown.[5] To assist in the management of a child with anxiety, several dental studies[6,7] have shown that distraction is a common technique used to reduce the pain reaction during short invasive procedures. Distraction techniques such as television watching, use of virtual reality, and audiovisual (AV) eyeglasses, may effectively help to distract the child's attention away from anxiety-provoking stimuli, leading to a relaxing experience for the child.[8-10]

It is relatively difficult to explain the concept of local anesthesia and its administration and effect to a child with hearing disability.[1] Especially, anxious patients perceive more pain of longer duration as compared to less anxious patients.[6] Several studies[11-12] documented that computerized delivery system-intrasulcular (CDS-IS) system for local anesthesia caused low levels of stress and pain reaction. The CDS-IS permits controlled low-pressure delivery of the anesthetic solution.

The current study aimed to assess the effectiveness of behavioral modification techniques Tell-Show-Do in combination with visual distraction with/without video eyewear using CDS-IS for application of local anesthetic in hearing-impaired pediatric patients undergoing pulp therapy of primary molars.

METHODOLOGY

This randomized, crossover clinical study included 15 children (7 boys and 8 girls) aged 5–7-year-old. Research approval obtained from the Research Ethics Committee, University of Sharjah, United Arab Emirates. Children, *n*=6 of severe, and *n*=9 of profound types of auditory deficits, according to their medical records, were recruited. They had no systemic disorders that prevent them from undergoing invasive dental treatment and had previous dental experience. Treatment was planned as three sessions, which were 1-week apart.

During Session I

The parents were asked to fill out information related to patient's age, severity of hearing impairment (slight, moderate, and profound), any comorbid factors (seizure), communication skills, and preferences. Meanwhile, their children were given the option to select their choice of movie from the collection of "Treehousetv.com" website which has cartoons designed for children with hearing impairment. These cartoons were later projected on the ceiling above the dental chair.

Employing Tell-Show-Do, methods of behavior management techniques, using graphic animation of dental caries, and its treatment was shown to these children on iPad. In addition, using dental model, children were introduced and shown how suction, drill, and air-water syringe feels and works in a playful way. These children were then seated on the chair and made them watch their preselected 10 min long age-appropriate cartoon movie with sign language interpretations, projected on the ceiling above dental chair. One pediatric dentist did the prophylactic cleaning of their teeth in upper jaw. Before using rotating instruments or the suction, children were asked to turn off the hearing aid. Then, they were introduced to video eyewear (Vuzix Wrap 310XL; Vuzix Corporation, Rochester, NY, USA) which was attached to the iPad to watch another preselected movie, while the same dentist while performed prophylactic cleaning of their lower jaw.

Following this, to assess the level of anxiety, children were asked to answer questions by selecting appropriate faces as set response in the "Smiley Faces Program (SFP)" with the help of their parents. We used the old version of SFP introduced by Buchanan in 2005,[13] consisting of four items (visiting dentist tomorrow, sitting in the waiting room, having a tooth drilled, and injection in the gum). Each item of dental anxiety has a set of seven faces to choose from representing the feeling of children.

For systematic desensitization with vibrations from dental drills, they were given powered toothbrushes (oscillating-rotating type) as a reward for attending the first session. Parents were advised to either adjust or remove their hearing aids while they use these toothbrushes.

During Session II

Children who were randomly assigned to Group A had the first session of endodontic treatment using video eyewear, whereas Group B had undergone same treatment while watching a movie of their choice projected through a projector on the ceiling above the dental chair without video eyewear.

During Session III

During Session III, children in Group A, had pulp therapy done on another tooth in the different quadrant

with AV distractor without eyewear, but children in Group B wore video eyewear while watching cartoon movie while undergoing pulp therapy.

During Session II and III, blood oxygen saturation and pulse rate were monitored and recorded throughout the procedure in every 5 min using pulse oximeter for approximately 30 min of pulp treatment. All the treatment procedures were carried out by one pediatric dentist. Patients were anesthetized by CDS-IS machine. Root canal procedure started after rubber dam isolation. While deroofing the pulp chamber, few drops of local anesthetic were delivered intrapulpally when needed. At the completion of the endodontic procedure, the patients' were instructed to rate their pain during treatment procedure on the WBs' Faces Pain Scale.[14] A paired sample *t*-test and independent sample *t*-test were used to assess the significance of changes during each visit. The statistically significant was set at 0.05.

RESULTS

There was a random distribution of 15 subjects into one of two groups (A and B). In treatment Group A, there were 7 (3 boys and 4 girls) participants, whereas treatment Group B comprised 8 (4 boys and 4 girls) participants. There were no significant differences between the two groups related to gender ($P = 0.53$). The overall mean age of participants was 6.1 years (range, 5.2–7). The mean ages of the subjects in Groups A and B were 5.35 ± 0.61 and 5.42 ± 0.52 years, respectively [Figure 1].

During Session I, all the participants watched movie with sign-language interpretation with/without visual eyewear and prophylactic cleaning was done for all the participants. After 1 week, during Session II and III, both treatment groups had undergone pulp treatment [Figure 2]. In our study, using SFP when inquired about anxiety-provoking stimulus, majority answered local anesthetic injection (mean = 5.2, standard deviation [SD] = 1.8) followed by their experience with the drill (mean = 4.6, SD = 1.5).

At the end of Session I, the children rated the day before the dental visit as least anxiety provoking (mean = 1.4, SD = 0.5) followed by the waiting room scenario (mean 2.1, SD = 1.5), the children rated themselves most anxiety provoking with local anesthetic injection (mean = 5.2, SD = 1.8) followed by their experience with the drill (mean = 4.6, SD = 1.5) [Figure 3].

In treatment Group A, there was a statistically significant difference ($P < 0.04$) observed in pulse rate between the treatment Session II and III. For Group B, an increase in pulse rate between the Session II and III was observed although the difference does not represent any statistically significant ($P = 0.12$). There observed no statistically significant difference in oxygen saturation levels between the two sessions in either of the two groups [Table 1].

In Group A, the mean faces scale pain scores demonstrated a statistically significant increase ($P = 0.05$), between treatment Session II when children use video eyewear compared to Session III when they watched movie without it. The difference between the two operative mean pain score was different though not significant in Group B as self-reported mean pain score increases during treatment Session III with video eyewear [Table 2].

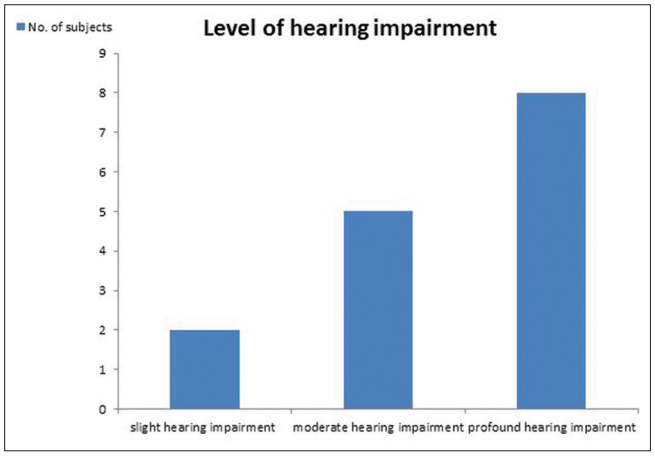

Figure 1: Children with severity of hearing disability

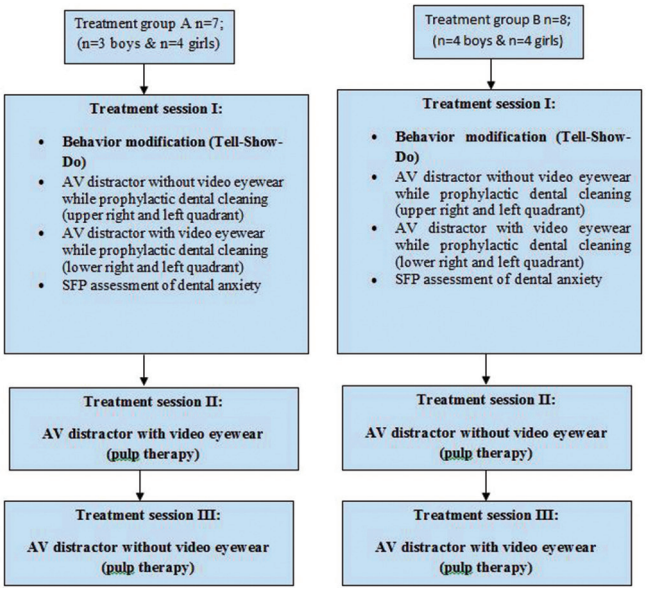

Figure 2: Patient flow through study

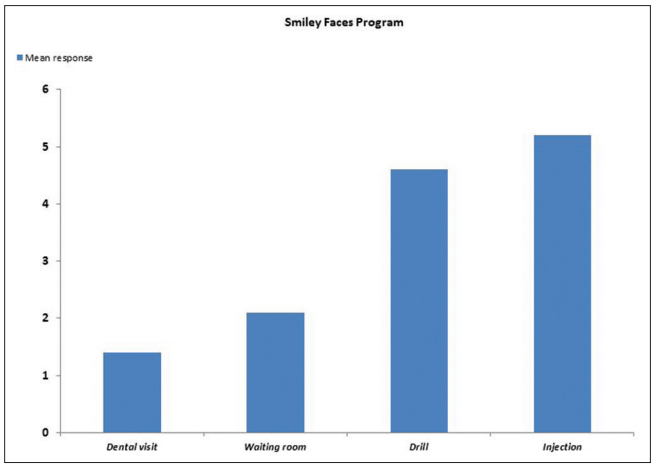

Figure 3: Across the Smiley Faces Program

Table 1: Mean change in pulse oximetry and heart rate

Groups	Mean±SD	
	Change in pulse oximetry	Change in heart rate
Group A		
Treatment Session II: AV distractor with video eyewear	3.56±1.61	5.98±2.03
Treatment Session III: AV distractor without video eyewear	2.62±0.49	3.12±1.08
*P**	0.45	0.04*
Group B		
Treatment Session II: AV distractor without video eyewear	2.62±1.06	3.41±1.02
Treatment Session III: AV distractor with video eyewear	3.48±0.67	5.52±1.05
*P**	0.41	0.12

**P*<0.05. SD: Standard deviation, AV: Audiovisual

Table 2: Mean change in pain severity in two groups during treatment sessions

Treatment groups	WB Faces Pain Rating Score (mean±SD)
Group A	
Treatment Session II: AV distractor with video eyewear	4.08±0.50
Treatment Session III: AV distractor without video eyewear	2.26±0.63
*P**	0.05*
Group B	
Treatment Session II: AV distractor without video eyewear	1.61±0.46
Treatment Session III: AV distractor with video eyewear	2.32±0.62
*P**	0.18

**P*<0.05. SD: Standard deviation, AV: Audiovisual, WB: Wong-Baker

DISCUSSION

Like many any other children, a child with hearing disability is afraid of the unknown.[15] To reduce their anxiety, we employed combination of behavioral modification techniques. By employing nonverbal communication through video demonstration, we tried to familiarize dental procedures to these children. Furthermore, these children may be quite sensitive to vibrations, so one has to carefully introduce instruments such as dental drills and suction.[16] To introduce and desensitized their visual, auditory, and tactile sensation, in a nonthreatening setting, we demonstrated using tooth model, how handpiece, suction, and air-water syringe sounds and works. Although some of these children were not familiar with the English sign-language. However, observing sign-language interpretation made these children felt connected, as it is meant for children who are just like them. In the current study, video distraction was used to divert patients' attention away from the perceiving unpleasant procedure, promote their learning, and improve general behavior. During treatment Session I, child's potential levels of cooperation, development, and anticipated reaction to dental procedures were assessed using Tell-Show-Do approach, modeling, and distraction techniques.

In contrast to our finding from the previous study[17] which demonstrated that the use of video eyewear may provide better distraction than watching video on a screen where occlusive eyewear projects, the images right in front of the eyes of the user, blocking out real world's visual and auditory stimuli; the present study demonstrated a significant increase in the heart rate for group who underwent pulp treatment while watching video using video eyewear. Furthermore, self-reported mean pain score increases during treatment sessions' with video eyewear for both groups. This suggests that for effective behavior management of children with hearing impairment, visual distraction with full visibility of the surrounding is advised to maintain visual contact because these children feel sudden shock or alarm if they are touched without visual contact.[16] We observed an increase in self-reported mean pain score for both groups during sessions with visual distractor using video eyewear. This could be attributed to the complete blockage of surrounding visual field provided by video eyewear which might trigger anxiety in children with hearing impairment to interpret and express it as pain.

Cooperation of the child can influence the decision to retain primary teeth by treating pulpal conditions.[17] An effective pain control is important to achieve comfort, cooperation, and compliance in children

during dental treatment.[18] In our study, we used CDS (Wand, Milestone Scientific, Inc., Deerfield, IL, USA) enabling slow-paced delivery of local anesthetic in small volume under a controlled low pressure of 165 pound/square inch. In addition, employing CDS-IS system enables the operator to control the disadvantages associated with an inferior alveolar block such as pain that affects child's behavior and avoids postoperative self-inflicted injuries (tongue or lip biting) owing to its localized effect, and bilateral procedures can be done during single session.[19-21]

The current study was performed on a small scale of children due to factors related to child availability and compliance to post-operative care. We do recognize that a further investigation on a bigger sample of hearing impaired children is recommended where the quality of hearing impairment can be assessed statistically.

CONCLUSION

Routine psychological (Tell-show-do) intervention along with visual distraction with full visibility of the surrounding and use of CDS-IS system for anesthetic delivery, is recommended as an effective behavior management technique for children with hearing impairment undergoing invasive dental treatment.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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