RESEARCH ARTICLE

Effectiveness of Visual Distraction with and without Virtual Reality Glasses in Reducing Dental Anxiety among Children with Hearing and Speech Disability: A Pilot Study

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Abstract

Aim and objective: To assess the effectiveness of visual distraction with and without virtual reality glasses in reducing dental anxiety among children with hearing and speech disabilities undergoing dental treatment.

Materials and methods: Twenty-four children with hearing and speech disabilities aged 6–12 years were selected and were randomly divided into three groups (N = 8). Children in group A received no distraction, group B received visual distraction using virtual reality (VR) glasses and group C received visual distraction without VR glasses during dental treatment. The anxiety levels were measured using PJS- Pictorial Scale and physiological parameters - before, during, and after a dental procedure. Then intragroup and intergroup comparison was done.

Results: Intragroup comparison showed that "During" and "Post" treatment anxiety scores were significantly ($p < 0.05$) lower than that of "baseline" in group B. Intergroup comparison of anxiety scores in the three groups, at all three intervals, showed a statistically significant difference in the "during treatment" anxiety score ($p = 0.049$) with least score in group B.

Conclusion: Visual distraction using VR glasses can be recommended as an effective distraction technique in reducing dental anxiety among children with speech and hearing disabilities.

Keywords: Behavior management, Dental anxiety, Distraction, Hearing impairment, Virtual reality.

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Introduction

Children with special health care needs (SCHN) are at a higher risk of poor oral health due to their inability to communicate and/or inadequate oral health education.[1] Among hearing disabled children, speech is affected in most children and the children cannot verbalize their concerns and fears during dental treatment due to communication barriers.[2] Therefore, dental treatment portrays a potential threat to the child which can induce stress, fear, and anxiety.[3] Conventional strategies in reducing anxiety are further compromised in hearing disabled children because of the communication barriers. Patients with hearing loss need to be helped to understand and also need to know how to communicate in the best way.[4] Since, the children cannot understand and respond to the instructions given to them, they are unable to comprehend and master the technique of oral hygiene practices and hence they exhibit poor oral hygiene.[5,6] To assist in the management of a child with anxiety, several dental studies have shown that distraction techniques such as television watching, use of VR, and audio-visual (AV) eyeglasses, may effectively help to distract the child's attention from anxiety-provoking stimuli, leading to a relaxing experience for the child.[7-9]

A newly implemented distraction method in dentistry is the use of VR. The first VR learning environment used in children with hearing disabilities was virtual reality education for the assisted living project (VREAL). This virtual environment enabled the students to learn basic life skills, and apply basic academic skills.[10,11] This study was designed to assess the effectiveness of visual distraction with and without VR glasses in reducing dental anxiety among hearing and speech disabled children.

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Materials and Methods

This study was conducted on 24 children (aged 6–12 years) randomly divided (computer-generated random numbers) into three groups of 8 each. The study was approved by the institutional

ethical committee. The children were screened priorly for dental assessment in the routine school dental health program for special children. Participants were recruited based on the following eligibility criteria:

Inclusion Criteria

- Children with moderate-to-severe speech and hearing impairment.
- Children who required oral prophylaxis based on simplified oral hygiene index scores.

Exclusion Criteria

- Children whose parents denied their participation.
- Children with other systemic diseases.
- Uncooperative children unable to cope up with examination procedure.

During the course of the study, we observed that there was no tool to assess anxiety exclusively among hearing and speech disabled children. Therefore, an innovative anxiety assessment scale - PJS- Pictorial Scale was designed and validated for these children.

A common dental procedure i.e., oral prophylaxis was carried out for all three groups. The selected participants were randomly allocated to three groups:

- **Group A (control group)**: Without any distraction.
- **Group B:** Visual distraction using VR glasses.
- **Group C:** Visual distraction Without VR glasses (7-inch screen tablet).

An independent observer recorded baseline anxiety scores and physiologic parameters using the PJS- Pictorial Scale, pulse rate, and blood pressure using a digital sphygmomanometer at three intervals i.e., before, during, and after treatment. Children were educated about sign language specific to oral prophylaxis procedures by the trained principal investigator [Indian sign language (ISL)] with the help of visual aids. An ISL interpreter was also present throughout the treatment procedure. Children were sensitized regarding the use of the dental equipment - ultrasonic scaler, suction, drills, air-water syringe, etc., and instructed regarding the use of VR glasses. Oral prophylaxis procedure was carried out for all three groups and children were asked to turn off their hearing aids (if any) before the start of the procedure (Fig. 1).

Fig. 1: Oral prophylaxis without any distraction

A customized animated educational video was played as a distraction tool throughout the procedure in groups B and C (Fig. 2). The content of visual distraction used in this study was related to oral health education and consisted of information regarding the importance of primary and permanent teeth, brushing and flossing techniques, and dietary habits (Fig. 3). The main character was a child so the children could relate better. The video was explained by a sign language expert using ISL in the left corner of the screen (Fig. 4). The video had English and Regional language subtitles for ease in comprehension. At the end of the dental procedure, all the groups received oral health education, brushing instructions, dietary counseling in ISL/Lip reading by the trained principal investigator (Fig. 5). The collected data were organized, tabulated, and subjected to statistical analysis.

Results

Statistical analysis using Wilcoxon signed ranks test, Kruskal Wallis test, Mann-Whitney test, and Post-hoc Bonferroni was done using SPSS 17.0. The *p*-value was set at <0.05.

There was a random distribution of 24 subjects into one of three groups (A, B, and C). In control group A, there were 8 (5 boys and

Fig. 2: Oral prophylaxis with visual distraction using VR glasses

Fig. 3: Oral prophylaxis with visual distraction without VR glasses

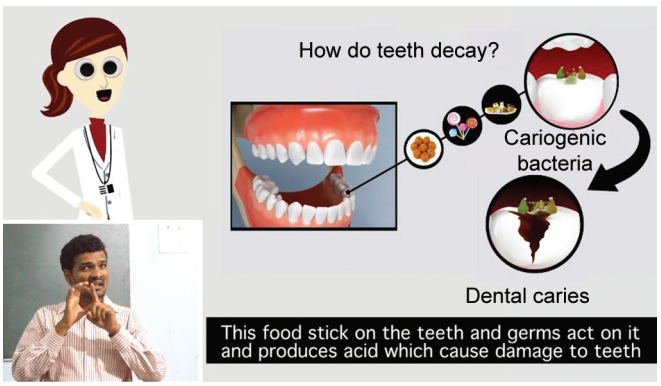

Fig. 4: Customized animation video on oral health education for hearing and speech impaired children in English

Fig. 5: Customized animation video on oral health education for hearing and speech impaired children in regional language

Table 1: Descriptive statistics and intragroup comparison of anxiety scores (PJS-PS) in groups A, B, and C

	Anxiety scores (PJS–PS) in all 3 groups				
Group	*At baseline (Mean ± SD)*	*During treatment (Mean ± SD)*	*After treatment (Mean ± SD)*	*χ2*	*p-value*
A	3.38 ± 0.518	3.50 ± 1.31	1.88 ± 1.13	9.852	0.007[a]
B	3.00 ± 0.76	2.25 ± 0.89	1.13 ± 0.35	13.556	0.001[a]
C	3.25 ± 0.71	2.88 ± 0.64	2.38 ± 0.92	3.769	0.152

SD, standard deviation; χ^2, Chi-square test; [a]statistical significance ($p < 0.05$) using Friedman test

Tables 2: *Post-hoc* test for comparison of PJS-PS score at baseline, during treatment and after treatment for groups A, B and C

	Without any distraction (Control group A)	*Distraction with VR glasses (B)*	*Distraction without VR glasses (C)*
	PJS-PS Mean difference (p-value)	*PJS-PS Mean difference (p-value)*	*PJS-PS Mean difference (p-value)*
Baseline vs During treatment	–0.12 (0.739)	0.75 (0.034)[a]	0.37 (0.180)
During vs After treatment	1.62 (0.017)[a]	1.12 (0.024)[a]	0.50 (0.340)
Baseline vs After treatment	1.50 (0.024)[a]	1.87 (0.011)[a]	0.87 (0.068)

[a]Statistical significance (*p*-value < 0.05) using Wilcoxon signed-rank test

3 girls) participants, group B comprised of 8 (7 boys and 1 girl), in group C there were 8 (6 boys and 2 girls) participants.

In group B (Table 1), the mean anxiety score demonstrated a significant decrease in treatment anxiety scores from baseline to during and after treatment ($p < 0.05$). In group C, there was no significant difference found between all three interval anxiety scores ($p > 0.05$). The difference in physiologic parameters in all groups and at all three intervals was not found to be significant.

In group B (Table 2), in which visual distraction using VR was provided, a significant decrease in anxiety score from baseline to during and after the treatment was observed. It was also observed that there was a significant decrease in "after" treatment anxiety than that of "baseline" and "during" treatment value in group A. On the other hand, there were no significant differences found for changes in anxiety scores (at all intervals) in group C.

It was found that there was no significant difference between baseline mean rank anxiety scores. There was a significant difference observed in during and after treatment anxiety scores between all three groups. In group B, "during and after" treatment means rank anxiety scores were found to be least in comparison to the other two groups ($p < 0.05$). The differences in physiological parameters at all three intervals were not found to be significant between the groups.

The use of VR glasses for distraction showed a significant decrease in mean rank "during" and "after" anxiety scores in group B in comparison with groups A and C, respectively (Table 3).

Discussion

Children with special health care needs are more prone to dental anxiety and therefore, exhibit poor oral health.[6] The speech and hearing-impaired children cannot verbalize their concerns and fear dental treatment. Therefore, dental treatment portrays a threat to the child which can induce anxiety. When a child with speech and hearing impairment reports to a dental clinic, routine management protocol will not be suitable because of various barriers. Hence, strategies for reducing anxiety are further compromised.

Chandrashekhar et al. demonstrated that a high proportion of hearing-impaired children suffered from dental anxiety, thus requiring measures to overcome them.[12] It is a serious concern for both dentist and patient for the provision of dental care. There are very few studies available in the literature that focus on dental

Table 3: Pairwise intergroup comparison of anxiety scores values at during- and after-treatment

	Group	*N*	*Mean rank*	*Sum of ranks*	*Mann-Whitney U*	*Z-value*	*p-value*
During treatment anxiety score	A	8	11.00	88.00	12.0	–2.162	0.031[a]
	B	8	6.00	48.00			
After treatment anxiety score	A	8	10.13	81.00	19.0	–1.667	0.095
	B	8	6.88	55.00			
During treatment anxiety score	B	8	7.00	56.00	20.0	–1.403	0.161
	C	8	10.00	80.00			
After treatment anxiety score	B	8	5.31	42.50	6.5	–2.912	0.004[a]
	C	8	11.69	93.50			
During treatment anxiety score	A	8	10.31	82.50	17.5	–1.594	0.111
	C	8	6.69	53.50			
After treatment anxiety score	A	8	7.19	57.50	21.5	–1.155	0.248
	C	8	9.81	78.50			

N, number of subjects; Z, overall rank mean; [a]statistical significance (p-value < 0.05) using Mann-Whitney test

anxiety among hearing and speech impaired children and the use of behavior modification methods for improving their dental experience.

In the present study, it was observed that the majority of the children had poor oral hygiene and high pretreatment anxiety scores. Similarly, Sandeep et al.[13] and Jain et al.[14] observed that children with hearing impairment have poor oral health and extensive treatment needs.

Renahan et al.[15] in 2017 observed that using sign language made the child feel comfortable in the dental setting, pictures and models were able to attract the child's attention and distract the child from the treatment procedure. In order to reduce anxiety among these children, we employed a combination of behavioral modification strategies such as–visual aids and sign language for effective communication and using video distraction. By employing suitable communication methods and distraction using video, we tried to familiarize dental procedures and educate about the importance of dental hygiene to these children, thereby, improving their dental experience by reducing their anxiety.

Hearing-impaired patients have the same rights to full information as other patients. Inadequate communication may cause anxiety and create problems for the professional if the patient does not follow treatment instructions properly. Arunakul et al.[16]and Ashwini K et al.[17] observed that visually appealing educational aids helped children with hearing and speech impairment to understand and comprehend better and also led to improvement in their oral hygiene scores. Therefore, in this study visual aids were also used for sensitizing the children about the procedure such as - use of an ultrasonic scaler, use of suction, use of a drill, and air-water syringe. All the groups received instructions in ISL/lip reading prior to the oral prophylaxis procedure by the trained principal investigator.

Dental anxiety is multidimensional and hence in this study both psychological components (PJS-PS Expansion - Prathima, Jaikiran, Sanguida 's Pictorial Scale) and physiological components (pulse rate and blood pressure) were measured. In the present study, there was no significant difference observed in pretreatment anxiety scores among all three groups. The anxiety scores recorded "during and posttreatment" were found to be significantly (p = 0.001) reduced in group B. In group C, reduction in anxiety scores was observed although the difference was not significant (p = 0.152).

In contrast to our findings, a study conducted by Fakhruddin et al.[18] found that psychological (Tell-Show-Do) intervention, visual distraction with full visibility of the surrounding environment was an effective behavioral management tool, for these children receiving invasive dental care. They observed that using occlusive eyewear for distraction among the children led to an increase in their heart rate and also an increase in self-reported pain scores. In the present study, children were instructed regarding the use of VR glasses prior to the procedure and an ISL interpreter was also present throughout. Hence, the children were comfortable with the use of VR glasses.

The difference in physiologic parameters in all three groups was found to be insignificant. Similar results for pulse rate changes were observed in the study conducted by Fakhruddin et al.[18]

Champion et al.[19] evaluated difficulties experienced by hearing-impaired children in accessing dental care and/or in receiving dental treatment. In the present study, most of the issues raised by the hearing-impaired children respondents were overcome by utilizing simple sign language. Therefore, children were able to express their thoughts and feelings easily to the principal investigator, during the procedure using the signs such as stop, suction, pain, and so on. This showed that an element of control and also means of communication was provided for the children. Removing masks while talking, standing towards the light source, reducing background noise, and learning to use simple signs led to improvement in communication with speech and hearing-impaired children.[3]

Limitations

The present study was conducted with a smaller sample size (related to child availability). A larger sample size including children of both gender and different age groups are recommended.

Conclusion

Video distraction using VR glasses is recommended as an effective behavior management technique for children with speech and hearing impairment.

This study also concludes that providing dental treatment along with proper instructions prior to the procedure according to the preferred method of communication to the children can also reduce anxiety during the course of the dental treatment.

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