ORIGINAL RESEARCH

A Comparative Study to Evaluate the Effectiveness of Different Modes of Oral Health Education Aids in Children with Autism Spectrum Disorder

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Abstract

Aim: The purpose of this study was to evaluate the effectiveness of different oral health education aids in children with autism spectrum disorder (ASD).

Materials and methods: The present study included a total of 90 children with ASD aged 10–15 years. The children were assigned to three groups. Group A was provided oral health education using visual cards, group B with a mobile-based application (Brush Monster™), and group C with video modeling. All the children were screened to note the plaque and gingival index (GI) and were assessed at baseline, 6, and 12 weeks.

Results: A significant difference in plaque scores ($p = <0.001$) and gingival scores ($p = <0.001$) was observed within the groups after 6 and 12 weeks postintervention. There was no statistically significant difference in dental plaque scores and gingival scores between the groups at all the timelines.

Conclusion: In this study, visual cards, a mobile-based application (Brush Monster™), and video modeling significantly reduced dental plaque and gingival scores. Hence, all these modalities can be used as effective tools in educating children to improve their oral hygiene.

Clinical significance: Poor oral hygiene can result in numerous complications for children with autism. Therefore, providing specialized education to raise awareness about oral hygiene offers significant benefits for these children in multiple aspects.

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Keywords: Audiovisual aid, Autism spectrum disorder, Behavior management, Oral health, Oral hygiene.

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Introduction

Autism spectrum disorder (ASD) is a term used to describe a range of neurodevelopmental conditions. The global prevalence of ASD is 0.76%, which represents around 16% of the world's child population, out of which over 2 million individuals in India could be living with this disorder.[1,2] The common onset of ASD is in the early age of life, especially during the first 3 years, with more prediction in boys than girls.[3] Symptoms emerge gradually after the 6th month, become well-defined by age two or three, and typically persist into adulthood, often in a less pronounced manner.[4] Children with ASD exhibit deficits in social communication, interaction, and repetitive patterns of behavior.[5] Social communication and coping with others can take many forms, including a shortfall in socioemotional mutual interaction, deficiency in gaining consolidated verbal and nonverbal communication, and the inability to start or comprehend the concept of relationships with others and make friends.[6] These children tend to consume sweets and soft foods, which may endanger oral health. As they lack manual dexterity, inadequate brushing is seen, which further leads to poor oral hygiene. One of the easiest and most efficient ways to avoid oral illnesses is to brush your teeth properly. These children's failure to follow oral hygiene practices is due to their extreme sensitivity, fear of using a toothbrush, and aversion to tooth brushing.[7] Therefore, to offer dental treatment and establish regular oral health self-care routines, they frequently need specific approaches that account for their behavioral and neurocognitive symptoms.

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Several fundamental behavior guidance techniques have been suggested for conducting dental treatment on autistic patients, such as involving parents, employing the tell-show-do method, giving brief, clear instructions, and using differential verbal reinforcement. The most efficient therapeutic approach is recognized as behavioral intervention. Careful consideration is needed when designing interventions for oral health education targeted at children with ASD. Training dental professionals to better understand and meet the needs of children with ASD involves a combination of education, practical skills development, and ongoing support. Firstly, it is important to deliver information on the significance of good oral hygiene and correct tooth-brushing techniques in an engaging and appealing manner to both the children and their

caregivers. Additionally, the interventions must address the sensory sensitivities of these children. Examples of such behavioral therapies include applied behavior analysis (ABA) and the treatment and education of autistic and related communication-handicapped children (TEACCH) program. Key examples of these programs include video modeling, utilizing picture exchange communication systems with visual cards, and delivering oral health education through audiovisual mobile applications.[8,9]

Although extant research suggests that some studies have utilized video modeling or visual pedagogy to teach children with ASD about dental hygiene,[10] there is a significant paucity of study on the efficacy of mobile applications built for this purpose. As a result, this study was designed with the aim of assessing the effectiveness of an interactive mobile application based on an oral health education tutorial in promoting oral hygiene among 10–15-year-old children with ASD attending special schools in Hyderabad. Furthermore, the study intends to compare the efficiency of this mobile application to visual pedagogy and video modeling as a tool for oral health teaching in these youngsters.

Materials and Methods

Ethical Approval

This research received approval from the Institutional Review Board (IRB) Sri Sai College of Dental Surgery & Hospital, Vikarabad, Ref No. (771/SSCDS/IRB-E/2021-22).

The protocol of the study was registered in the Clinical Trial Registry of India. The protocol of the study was accepted after review, and the registration number was CTRI/2023/08/56407.

Sample Size Determination

The sample size for this study was estimated using the mean and standard deviation of plaque G*Power software (version 3.0.10) was utilized for the calculations. With this data, the required sample size was determined to include three groups, each consisting of 30 participants, considering an alpha error (α) of 0.05 and a statistical power (1–β) of 0.95.

Group A: Visual Pedagogy for Oral Hygiene Practice

The visual pedagogy placode 7 × 9 cm with brief instructions at the bottom was given to each child for use at home (Fig. 1). It had seven color pictures, which showed six quadrants of the mouth that need brushing and minimal rinsing of remaining toothpaste.

Group B: Mobile-based Application (Brush Monster™)

The mobile application features a three-dimensional (3D) animation video and is available for free download on the Google Play Store. Initially, the mobile app opens with a home page that records the demographic details of the child. After filling out the concerned forms, the character appears on the screen with green-colored dirt stuck to its teeth. The animated cartoon encourages users to pick up a toothbrush and use the selfie mirror on the screen. Upon touching the screen, the character demonstrates a method for brushing teeth. Along with the visuals, audio was also available. Parents were explained about the app (Fig. 2).

Group C: YouTube Video

The video features an animated character presenting the brushing technique in an engaging and attractive manner, complemented by a background score to emphasize key aspects of the modified bass technique (https://youtu.be/Ku-ForS6G3I?si=Mtgp_3Xx7t0ZU4Lp). Informed consent was obtained from the parents/guardians of the children.

Sample Selection

Inclusion Criteria

Children aged 10–15 years with ASD, who exhibit plaque scores of 2 and 3, were included.

Exclusion Criteria

Children with conditions other than ASD.
Children lacking parental/guardian consent.

Children with any of the following missing teeth (16, 12, 24, 36, 32, 44).

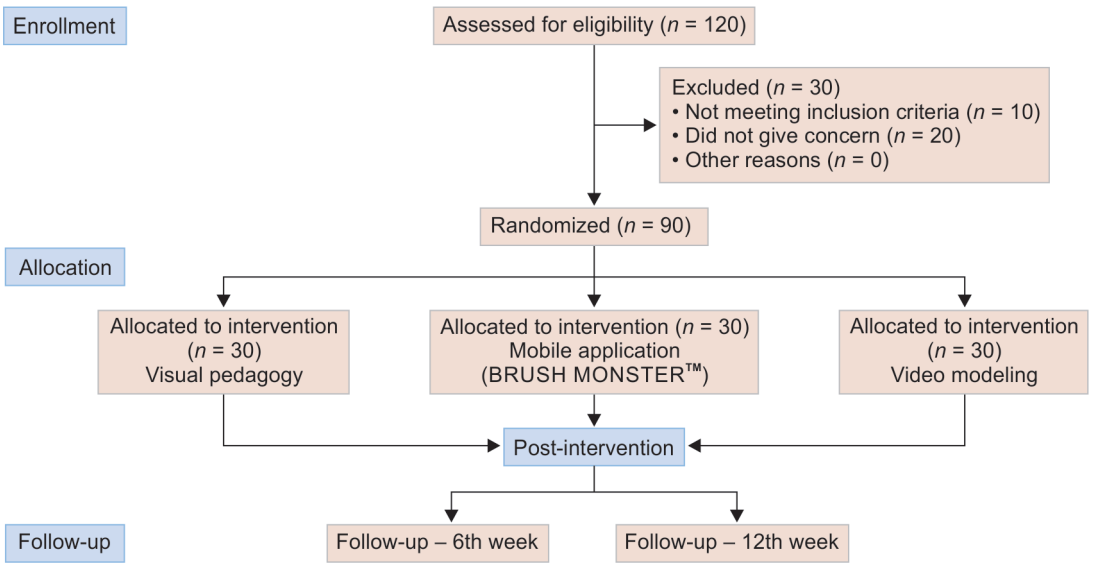

Fig. 1: Diagrammatic representation of visual pedagogy for oral hygiene practice

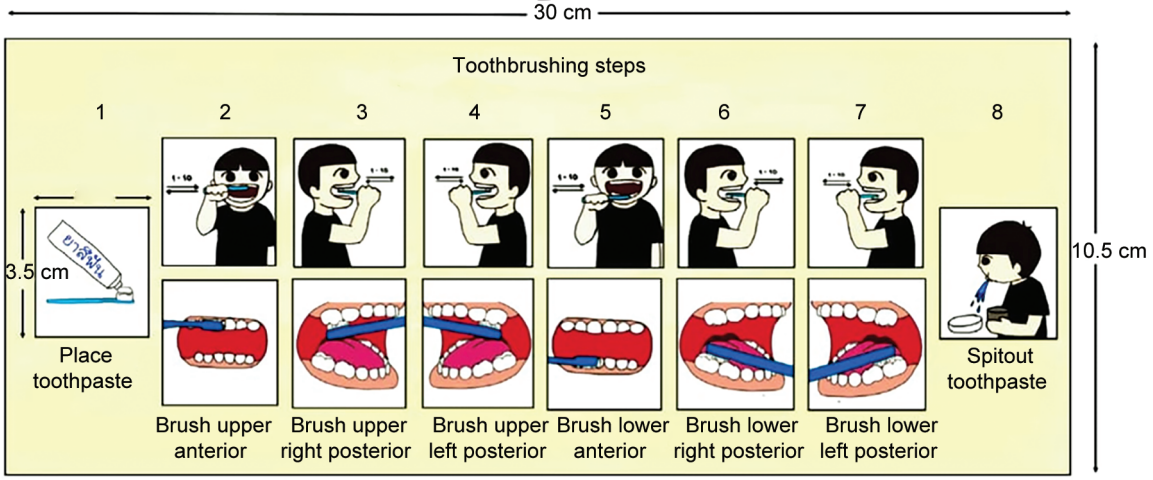

Fig. 2: Diagrammatic representation of mobile-based application

Fig. 3: Examination of children's oral health using periodontal probe

Collection of Data

The children's oral health was evaluated intraorally at baseline, 6, and 12 weeks. PI and gingival index (GI) were measured using the proforma provided by Lobene et al. and Silness and Loe. To administer the interventions and record the scores, a lone examiner and a recorder received sufficient training. The children's oral health was assessed by the examiner using a periodontal probe, mouth mirror, explorer, and natural light (Fig. 3). For every child, the examination period was standardized at 10 minutes (Fig. 4).

Statistical Analysis

Statistical analysis was conducted using the Statistical Package for the Social Sciences software for Windows, version 21.0. The Wilcoxon signed-rank test was utilized to compare mean scores between different time points for gingival and plaque scores, as well as within groups. A p-value of <0.05 was considered significant. The Kruskal–Wallis test was employed to compare between groups,

Fig. 4: Examination of children's oral health using mouth mirror, explorer, and natural light

while the Friedman test was used to analyze differences among the groups.

Results

In the present study, most of the children were 14 years old (30%), followed by 13 years old (13%), then 12 years old (14.4%), 11 years old (12.2%), and 10 years old (10%) (Fig. 5). Among 90 children included in the study, 57.7% were males and 42.2% were females (Figs. 6 and 7).

There is no statistical significance between the groups at baseline, 6, and 12 weeks follow-up (Table 1). A high statistical significance was found between the baseline, 6th-week, and 12th-week follow-up plaque index scores (Table 2). At baseline, group A had a plaque score of 2.52, group B had 2.63, and group C had 2.64, indicating poor oral hygiene. By the 6th-week follow-up, these scores improved to 1.86, 1.99, and 1.1, respectively, suggesting fair oral hygiene compared to baseline.

By the 12th-week follow-up, plaque scores further declined to 0.95, 0.89, and 0.93, reflecting good oral hygiene across all groups. This steady reduction in plaque scores within each group was statistically significant (Table 3).

At baseline, there was no statistically significant difference in gingival scores among groups A, B, and C. Similarly, no significant differences were observed between the 6th and 12th-week follow-ups (Table 4). However, a highly significant difference was noted in GI scores when comparing baseline, 6th-week, and 12th-week follow-ups (Table 5).

At the baseline assessment, gingival scores for groups A, B, and C were 2.52, 2.63, and 2.64, respectively, indicating poor oral hygiene. By the 6th-week follow-up, these scores decreased to 1.86, 1.9, and 1.9, suggesting fair oral hygiene. Further improvement was observed at the 12th-week follow-up, with scores dropping to 0.55, 0.94, and 0.7, indicating better oral hygiene status, demonstrating a uniform decrease in score in all three groups. Intragroup comparison of gingival scores was found to be statistically significant between the groups (Table 6).

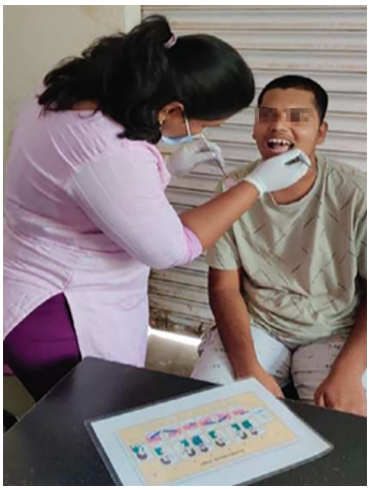

Fig. 5: Distribution of children based on age

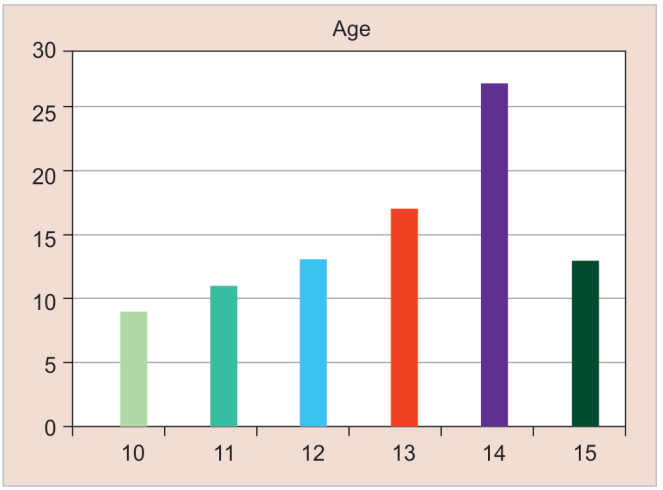

Fig. 6: Distribution of children based on gender

Table 1: Comparison of dental plaque index scores between groups A, B, and C at baseline, 6, and 12 weeks

Time points	*Groups*	*Kruskal–Wallis test p-value*
Baseline	A	1.90
	B	
	C	
6th week	A	0.73
	B	
	C	
12th week	A	0.69
	B	
	C	

Table 2: Comparison of dental plaque index scores within groups A, B, and C at baseline, 6, and 12 weeks

Groups	*Time points*	*Wilcoxon sign-rank test p-value*
A	Baseline and 6 weeks	0.04*
	6 and 12 weeks	
	Base line and 12 weeks	
B	Baseline and 6 weeks	0.01*
	6 and 12 weeks	
	Base line and 12 weeks	
C	Baseline and 6 weeks	0.00
	6 and 12 weeks	
	Baseline and 12 weeks	

*Statistically significant

Table 3: Distribution based on the dental plaque index scores at baseline, 6, and 12 weeks among groups A, B, and C

Groups	*Time points*	*Mean ± SD*	*Friedman test p-value*
A	Baseline	2.52 ± 0.31	0.023*
	6 weeks	1.86 ± 0.48	
	12 weeks	0.95 ± 0.65	
B	Baseline	2.63 ± 0.28	0.014*
	6 weeks	1.99 ± 0.51	
	12 weeks	0.89 ± 0.70	
C	Baseline	2.64 ± 0.26	0.034*
	6 weeks	1.99 ± 0.43	
	12 weeks	0.93 ± 0.67	

*Statistically significant

Table 4: Comparison of GI scores between groups A, B, and C

Time points	*Groups*	*Kruskal–Wallis test p-value*
Baseline	A	1.00
	B	
	C	
6th week	A	0.93
	B	
	C	
12th week	A	0.81
	B	
	C	

Table 5: Comparison of Gi within groups A, B, and C at baseline, 6, and 12 weeks

Groups	*Time points*	*(Wilcoxon sign-rank test) p-value*
A	Baseline and 6 weeks	0.010*
	6 and 12 weeks	
	Baseline and 12 weeks	
B	Baseline and 6 weeks	0.027*
	6 and 12 weeks	
	Baseline and 12 weeks	
C	Baseline and 6 weeks	0.000*
	6 and 12 weeks	
	Baseline and 12 weeks	

*Statistically significant

Table 6: Comparison of GI at baseline, 6, and 12 weeks among the groups

Groups	*Time points*	*Mean ± SD*	*Friedman test p-value*
A	Baseline	2.52 ± 0.31	0.028*
	6 weeks	1.86 ± 0.48	
	12 weeks	0.55 ± 0.54	
B	Baseline	2.63 ± 0.28	0.013*
	6 weeks	1.99 ± 0.51	
	12 weeks	1.94 ± 0.71	
C	Baseline	2.64 ± 0.26	0.000*
	6 weeks	1.99 ± 0.43	
	12 weeks	0.71 ± 0.69	

*Statistically significant

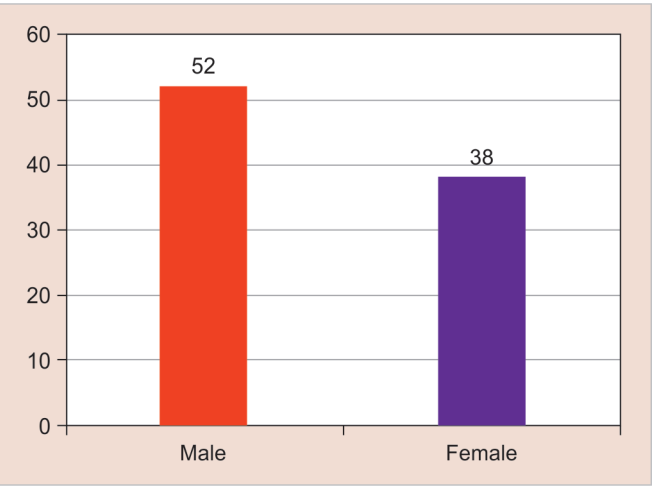

Fig. 7: Distribution of children based on age

Discussion

Autism Spectrum Disorders (ASD) children receive poor oral health care than the general population which may result in severe discomfort and other health problems. This can be prevented by simple routine habits and adequate follow-up. [11]

Children with ASD often experience poorer oral health care compared to the general population, which can lead to significant discomfort and other health complications. However, these issues can be minimized through basic routine practices and proper follow-up care. Autistic children face not only the neurobiological challenges associated with the condition but also emotional and psychological factors, which add complexity to clinical research efforts. In the present study, three different oral health education methods were undertaken through which these children could easily brush their teeth and were compared for gingival and plaque index. This showed a significant reduction of plaque and gingival scores within the groups.

Autistic individuals often learn more effectively through visual aids rather than through written or spoken language. As a result, the Picture Exchange Communication System, also known as visual pedagogy, was created to assist individuals in developing communication skills.[12] In a study conducted by Pilebro and Bäckman, visual pedagogy increased the cooperative rate of children with ASD for dental care.[13] 3D animation is a technique that can visualize characters and simulate movements. With good design and characteristics such as visual effects, sound, and color, 3D animation will be more attractive to these children.[14] Since all the abovementioned characteristics were incorporated in the Brush Monster™ app, it was chosen as one of the interventions of the study. Doichinova et al. in their study stated that the picture system PECS (visual pedagogy) was a suitable method for teaching oral hygiene practice to children with autism who face difficulty with verbal and nonverbal communication. These results are in accordance with the current study.[15] Smutkeeree et al. evaluated the improvement in plaque scores after using visual pedagogy for 4 weeks, 3, and 6 months, compared to baseline levels. These findings are consistent with the results observed in our study.[16]

Krishnan et al. demonstrated that using visual cards and the mobile application "Brush Up" led to a significant reduction in dental plaque and gingival scores. This suggests that both methods are effective tools for educating children and improving their oral hygiene. Our study's results are consistent with these findings.[17] Asma'a et al. conducted a study on visual pedagogy and technology-based intervention and concluded that both are useful modes for improving oral hygiene. These results are inconsistent with our study.[18]

Therefore, our study demonstrated that improvement in oral hygiene could be due to the advocated proper tooth brushing method through innovative and attractive methods used to deliver the oral hygiene instructions to these children. Several studies have put forth the fact that autistic children are more attracted to inanimate objects than animate objects, and also these children have impaired sensorimotor perception.[19,20] As a result, inanimate objects can be effectively utilized to convey important messages to autistic children. Selecting the appropriate delivery method is crucial, and this study explores this aspect. Implementing these methods can lead to significant improvements in oral hygiene

among these children, proving to be both attractive and effective. Additionally, these approaches are cost-effective, simple, and easy to execute.

Conclusion

In groups A, B, and C, plaque and gingival scores significantly decreased at both the 6-week and 12-week time points. However, there was no statistically significant difference in plaque and gingival scores between the three groups, indicating that all interventions were equally effective in reducing plaque on tooth surfaces among these children. Therefore, all modalities can be considered effective tools for improving oral hygiene.

Clinical Significance

The focus of pediatric dentistry is placed on oral health education for specially disabled children, as they face functional limitations and a compromised diet due to poor oral hygiene. Therefore, more research and awareness in this area provide benefits to the child.

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