ORIGINAL RESEARCH

# Culturally Adapted Dental Visual Aids Effect on Behavior Management during Dental Visits in Children with Autism Spectrum Disorder

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## Abstract

**Aim:** Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by unique behavioral patterns, treating children with ASD in the dental clinic has been a great challenge due to their behavior. This study aims to determine the effectiveness of culturally adapted dental visual aids in modifying behavior patterns during dental visits in children with ASD.

**Materials and methods:** A controlled, blinded, randomized, clinical trial, with 64 children diagnosed with ASD, were randomly divided into two groups. The study took place between January 2019 and January 2021. The experimental group was provided with culturally adapted dental visual aids created especially for this research and the control group was provided with universal dental visual aids. The children's behavior patterns were evaluated before and after using the dental visual aids. SPSS v.25 was used to process all the data.

**Results:** Behavior patterns have modified significantly in the experimental group ($p < 0.001$) however, it was statistically insignificant in the control group ($p = 0.077$). In terms of behavioral patterns, the experimental group outperformed the control group significantly ($p < 0.001$).

**Conclusion:** The culturally adapted dental visual aids have shown effectiveness in modifying behavior patterns in children diagnosed with ASD during dental visits.

**Clinical significance:** By evaluating the impact of culturally adapted visual aids on behavior management, the study can enhance the accessibility and effectiveness of dental care for this vulnerable population, ultimately promoting better oral health outcomes and reducing potential trauma associated with dental visits for children with ASD.

**Keywords:** Autism spectrum disorder, Behavior management, Dental visual aids.

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## Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition known for its unique behavioral patterns of repetitive activities as well as defects in social skills and poor mutual communication.[1]

The exact causes of ASD are still unknown, many factors are believed to participate in the development of ASD, such as genetic, neurological, environmental, and immunological factors.[2] Rekha et al. revealed that prenatal environmental factors including taking medications during pregnancy such as antidepressants, especially in the first trimester, have been found to raise the chance of giving birth to a child having ASD. Moreover, poor nutritional intake in the first three months of pregnancy, specifically, poor folic acid intake also enhances the chance of giving birth to a child having ASD.[3]

There has been a huge escalation in the number of ASD prevalence from the end of the 1980s to the early 1990s. Reports explain this growth to be due to the development of diagnostic tests and the ability to diagnose ASD in a child at a very early age, sometimes starting as early as nine months only.[4,5]

The latest report issued by the National Health Center for Health Statistics (NHCHS) (2016), reported that ASD prevalence has reached its highest number of one in every 36 children.[6,7] In the Kingdom of Saudi Arabia, a study that assessed the ASD prevalence in the cities of Jeddah and Makkah has reported that the prevalence in both cities is 2.81 cases of ASD per 1000 children.[8]

Managing the behavior of children with special needs (CSN), particularly those with ASD, can be difficult.[9] The most effective behavior management strategy for such patients is early implementation of an intensive behavioral intervention called "Treatment and Education of Autistic and Related Communication Handicapped Children" (TEACCH), the most important examples of these programs are visual aids.[10]

Visual aids are a set of cards with pictures, each card explaining a step in their daily routine.[11] Developing dental visual aids that

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explain tooth brushing and dental visit steps was thought to be very effective in teaching children with ASD how to brush their teeth and communicate with the dental team, thus, promoting a positive attitude towards oral health.[12] A research used colored photographs showing each step of the dental appointment, along with dental visual aids they used tell–show–do (TSD), and they found that 77% of the participants were able to complete all dental appointment steps successfully.[13] Another study trained children for the steps of dental appointment using a sketch for each step to prepare children for the appointment, 92.8% of children accepted oral examination and professional teeth cleaning.[14]

Moreover, when dental appointment steps were demonstrated by dental visual aids in addition to TSD, it was found that the child's behavior distress level was lower when measured by physiological arousal levels in children who received dental visual aids than in children who received TSD-only.[15] A regional study observed the behavior of children with ASD during the first dentist visit after using a storybook to prepare for their first dental appointment.[16] Almost half of the children behaved positively during their first appointment according to "Frankl behavior rating scale".[17]

Managing the behavior of children with ASD during dental treatment is very difficult, even in simple dental procedures. Dental visual dental aids are used with such children to manage their behavior, the disadvantage of the ones available are not in our native Arabic language and do not represent our culture. We created our culturally adapted dental visual aids to be more understandable to children with ASD. The goal of the present study was to evaluate the efficacy of culturally appropriate dental visual aids in modifying behavior in children with ASD during dental treatment.

## Materials and Methods

The Research Ethics Committee at the Faculty of Dentistry at King Abdulaziz University (KAU) approved the study before starting the project under approval number 057–02–19. An identifying number NCT04576559 was assigned to this clinical trial at www.clinicaltrials.gov.

Open Epi program v.3 was used to calculate sample size based on previous literature done by Fakhruddin and El Batawi[18] which included children who attended the ASD diagnosis clinic at King Abdulaziz University Hospital (KAUH) between January 2019 and January 2021 for a duration of 24 months. Inclusion criteria were: Saudi Arabian patient, ages between 6 and 12 years, a patient showing classic triad signs of ASD: Social interaction deficits, language impairment, and rigidity of interests, confirmed by an ASD expert, ASD diagnosis confirmed in their medical files based on the DSM-V checklist listed by the American Psychiatric Association (APA) (2013), absence of previous dental experience, and diagnosis of mild to moderate ASD based on "childhood autism rating scale" (CARS).[19,20] Patients with congenital anomalies, for example, "Down Syndrome" were excluded.

The present study was a blinded, controlled, randomized clinical trial having a 1:1 allocation ratio. By using the simple randomization technique of tossing a coin, children were randomly separated into two groups based on the type of dental visual aid received, where every group had 32 children in it. Heads indicated the child was assigned to the experimental group, while the tails indicated the child was placed in the control group. On an Excel file created for blindness, each child acquired a special serial number that was associated with the assigned assigned group.

An observer and a principal investigator carried out the study, the principal investigator performed all the dental procedures. The observer recorded the observational scale of behavioral distress (OSBD), by observing the child's behavior from the minute he/she enters the dental clinic until the child leaves (Appendix A).[21] After the initial visit, the patient allocation group was concealed from both the principal investigator and the observer. In the subsequent dental appointment, each patient received a blank set of paperwork with a serial number that did not specify the kind of dental visual aids provided to them. Moreover, the data analyst was blinded to the analyzed data.

Interventions were executed as follows: (a) The experimental group received culturally adapted dental visual aids that were especially made for this study. They were developed by hiring a specific artist who drew colored graphics based on photographs of the actual location of the pediatric dentistry clinic at King Abdulaziz University Dental Hospital (KAUDH). Three ASD specialists, including ASD–specialized physician, child psychologist, and a behavioral psychologist, verified the culturally adapted dental visual aids. Prior to starting this investigation, an Arabic language specialist reviewed the language, as illustrated in Figure 1; (b) The universal dental visual aids provided to the control group were obtained from a website named age of autism (2019), as illustrated in Figure 2.[22]

These were recovered in their original English language and described to both the parents and children in Arabic. The principal investigator and parents agreed on a set of sentences that were taught to the children at home in Arabic on a daily basis.

The first visit was a preparatory visit for parents and was conducted at the ASD diagnosis clinic in KAUH, Jeddah, Saudi Arabia. The study was explained to the parents of the children by the main investigator. Those who agreed were interviewed by the main investigator and requested to answer a questionnaire, which was split into two sections: The first section asked about demographic information, such as age and gender, as well as parents' social and economic status derived from "Central Department of Statistics and Information in the Kingdom of Saudi Arabia" (CDSIKSA) (2019).[23] The second part of the questionnaire asked about the child's medical and dental history. Later, they were invited to start the dental visits at the pediatric dentistry clinics at KAUDH and were given an appointment one week later for the first dental visit (Appendix B). A demographic questionnaire was pretested on random parents to ensure an understanding of the survey questions.

During the first dental visit, the lead investigator asked the participant to sit in the dental chair. During this visit, TSD was the only behavior control strategy employed with children. For both groups, the first visit included: (1) oral exam; (2) plaque index scoring; (3) professional prophylaxis using non-fluoridated prophylactic paste on a rotary small cup using low–speed handpiece and (4) the principal investigator demonstrated oral hygiene instructions to the child and parents using a dental model, each participant was provided a copy of dental visual aids based on a random allocation sequence.[24] Parents were instructed to read and explain these dental visual aids to their children for at least fifteen minutes each day, for a minimum of four weeks.[14] Parents of both groups were contacted two weeks following the initial dental visit to ensure dental visual aids were explained to their children daily. The second dental visit was four weeks later, and both groups were recalled.

To begin the second dental visit, the principal investigator asked the participant to sit in the dental chair. Tell–show–do was the only behavior control approach employed with participants during the visit. The second visit for both groups included: An oral exam, plaque index scoring, and professional prophylaxis.[24]


**Fig. 1A:** The culturally adapted dental visual aids: Visiting the dentist

Participants who required further dental treatment were referred to postgraduate clinics.

The effectiveness of culturally adapted dental visual aids was assessed using OSBD.[21] It is a valid and reliable scale for measuring signs of distress in children undergoing painful medical/dental treatments such as needle injections.[21] It is easily used by professionals and does not need any special training. It is divided into eight "operationally defined behaviors" indicating the presence of anxiety or pain. Each sign is equal to one point. The more points recorded on the scale, the more negative behavior the child has.

A calibration session was held to guarantee the principal investigator and observer knew how to measure plaque index scores and record OSBD. Both intra-investigator reliability and intra-observer reliability were 100% respectively. The completeness of information in the evaluation charts was determined by selecting ten charts at random and examining them with another researcher experienced in ASD research. There was complete agreement among the examiners.

### Statistical Analysis

The "Statistical Package for the Social Sciences" (SPSS) software v.25 was used to process data. To provide an overview of the demographic data of children in the study, descriptive statistics such as frequency, percentage, and Chi-square tests were used. To describe descriptive data, mean and standard deviation (SD) were employed. The significance level for this study was set at 0.05, with a 95% level of confidence. Wilcoxon Signed–Rank test was done to compare differences in each group before and after using dental visual aids. To compare the mean ranks of the two groups, the Mann–Whitney test was used.

## Results

Sixty-four children from both groups completed all of the study's steps, as described by "Consolidated Standards of Reporting Trials" (CONSORT),[25] illustrated in Flowchart 1.

The present study comprised a sample of children ranging from six to twelve years old, with a mean age of eight years and two months. The experimental group had 21 males (65.62%) and 11 females (34.37%). The control group included 22 males (68.75%) and 10 females (31.25%).

Gender distribution was not statistically significant between groups ($p = 0.790$). The average age of ASD diagnosis was 5.5 years. In terms of ASD severity, 17 children in the experimental group had mild ASD (53.12%), and 15 had moderate ASD (46.87%). In the control group, 12 had mild ASD (37.50%), and 20 had moderate ASD (62.50%). The distribution of ASD severity between groups was not statistically significant ($p = 0.209$).

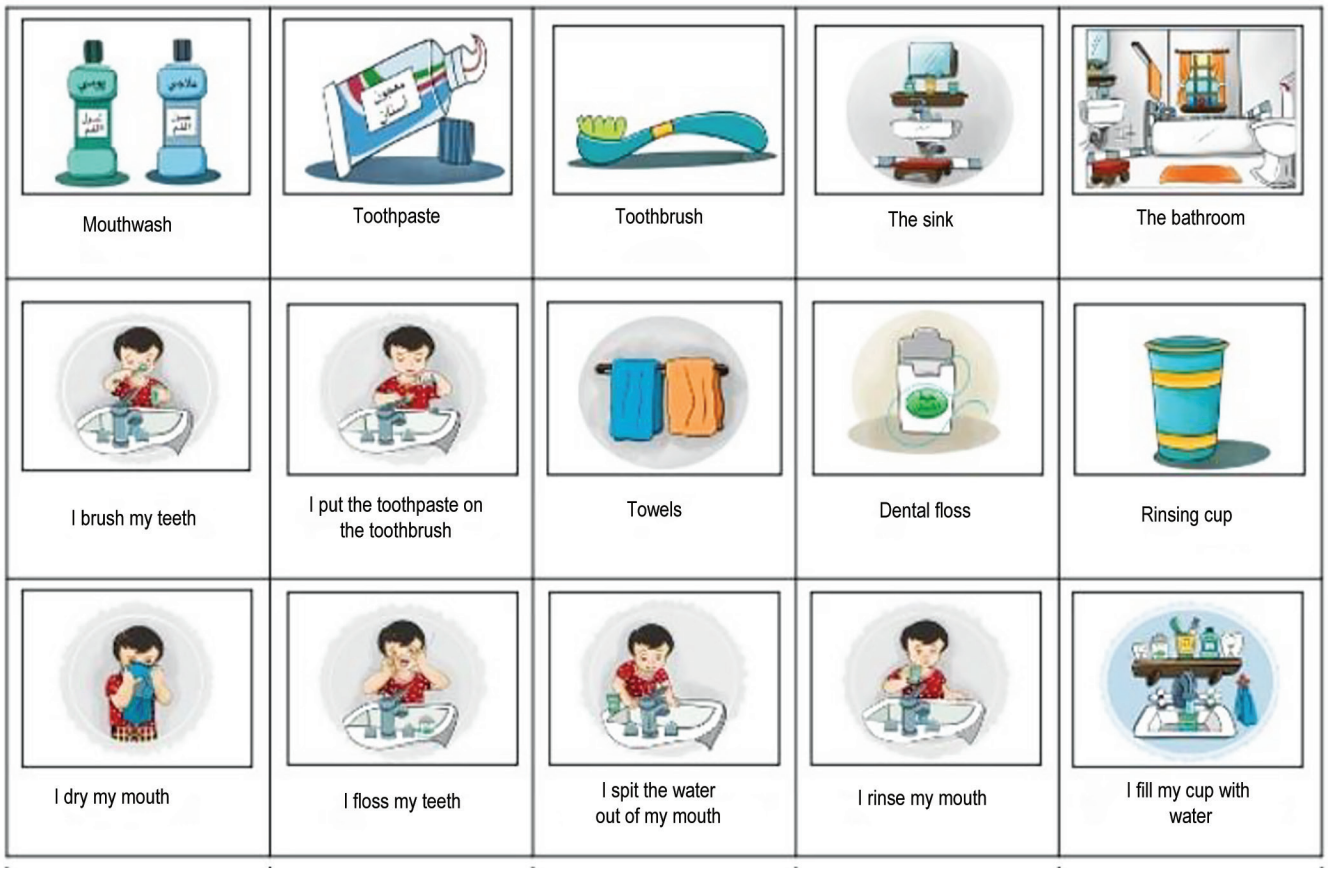



**Fig. 1B:** The culturally adapted dental visual aids: Brushing at home

In the experimental group, the number of children that expressed information-seeking, crying, and screaming was lower after using the aids and it was statistically significant ($p = 0.034$, $p = 0.025$, $p < 0.001$) respectively. Moreover, a lower number of children needed restraint by parents' hand during treatment after using the aids, and it was statistically significant ($p < 0.001$). In addition, a lower number of children expressed verbal resistance after using the aids, and it was statistically significant ($p = 0.002$). The number of children who needed emotional support from their parents during treatment decreased after using the aids, and it was statistically significant ($p < 0.001$). Finally, a lower number of children expressed verbal pain and flail after using the aids, and it was statistically significant ($p = 0.008$, $p < 0.001$) respectively.

In our control group, no children expressed information-seeking before or after using the aids, and it was not statistically significant ($p = 1.000$). The same number of children expressed crying before and after using the aids, and it was not statistically significant ($p = 1.000$). A number of children who expressed screaming was lower after using the aids, and it was statistically significant ($p = 0.021$). The lower number of children needed restraint by the parent's hand during treatment after using the aids, it was not statistically significant ($p = 0.257$). The lower number of children expressed verbal resistance after using the aids, and it was not statistically significant ($p = 0.796$). The same number of children needed emotional support before and after using the aids, and it was not statistically significant ($p = 1.000$). The number of children who expressed verbal pain increased after using the aids, and it was not statistically significant ($p = 0.102$). The lower number of children expressed flail after using the aids, and it was statistically significant ($p = 0.001$), as shown in Table 1.

The total score of OSBD was expressed as a mean in each group before and after using the aids to assess the effectiveness of the dental visual aids. The OSBD mean was lower in the experimental group after using the aids ($p < 0.001$). As shown in Table 2, there was no statistically significant difference in the control group after using the aids ($p = 0.077$).

We compared differences in OSBD before and after using dental visual aids between both groups. The group that received the culturally adapted dental visual aids had lower OSBD scores, and there was a statistically significant difference between both groups ($p < 0.001$), as shown in Table 3.

## Discussion

We compared our culturally adapted dental visual aids to the universal dental visual in modifying behavior in children with ASD. Delivering optimal dental care for children with ASD is challenging and requires a lot of training. Therefore, they need extensive behavior modification to overcome resistance to change in their daily routine and help them acquire new skills.[26] The present study is the first in the country to develop dental visual aids that mimic our actual dental setting, dental staff, and dental tools used in the dental appointment, while also teaching at-home teeth brushing. They also comply with our society, and culture, and are written in our native language.

Previous studies reported in the literature supported the creation of special dental visual aids,[27,28] that mimic actual dental settings allowing children to get familiar with the environment


**Fig. 2A:** The universal dental visual aids: Going to the dentist

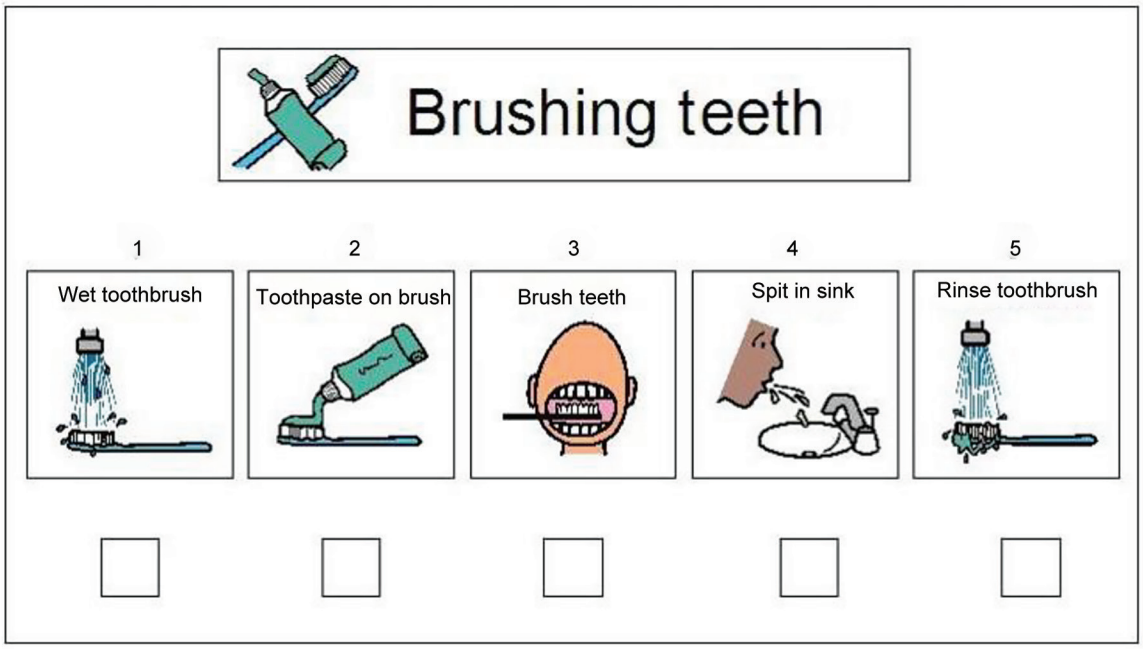
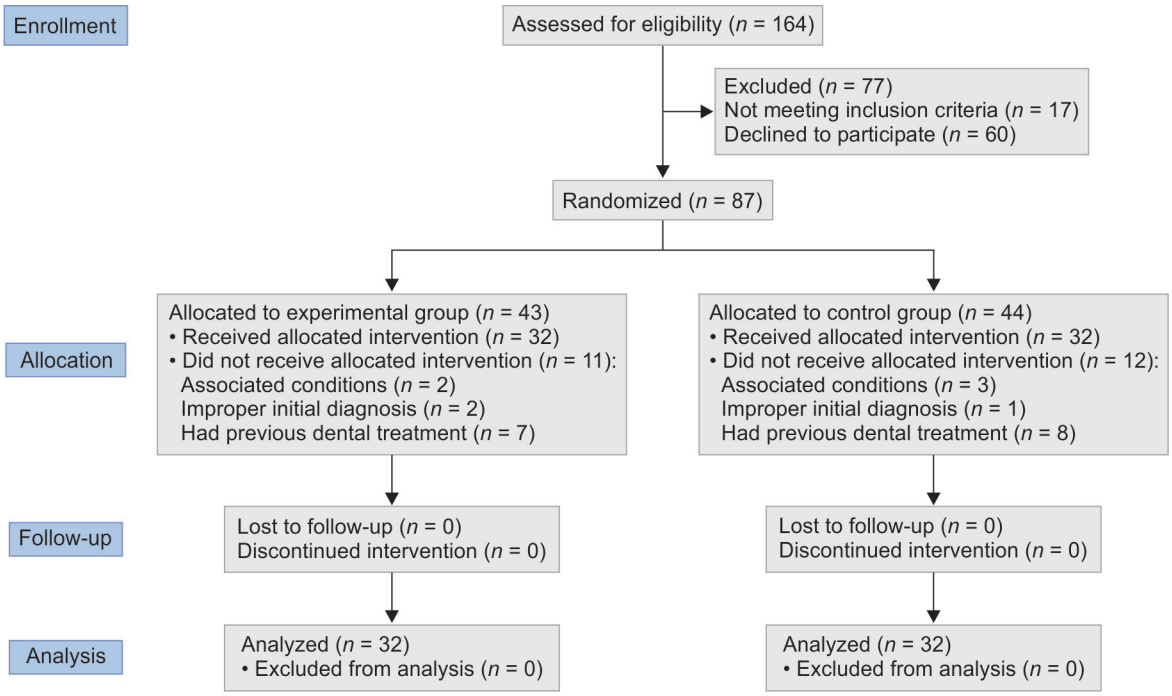



**Fig. 2B:** The universal dental visual aids: Brushing at home

**Flowchart 1:** The CONSORT transparent reporting of trials




they will encounter. In contrast, universal dental visual aids were retrieved from the webpage "age of autism" (2019),[22] for children in the control group. They comprised a series of pictures that illustrate the dental appointment steps and brushing at home steps. This type of dental visual aid is widely used by children with ASD worldwide.[15] However, children with ASD in Saudi Arabia are not familiar with it due to the language barrier, as they are written in English. To eliminate bias caused by comparing two dental visual aids in different languages; universal visual aids were explained verbally in Arabic for parents and children with ASD.

Females' percentage in the present study was 32.8% while males were 67.2%, which makes male to female ratio 2:1 which coincides with the gender distribution of ASD reported in the literature.[29] Our sample included children from six to twelve years with mean a age of eight years and two months. The age selection starting at six was due to the development of the motor ability of children at this age, where they can have a good grip on the dental brush during brushing and ending at 12 to minimize the possibility of puberty hormones negatively interfering with their behavioral patterns.[30,31]

**Table 1:** Frequency of OSBD within each group before and after the use of the dental visual aids

| | | Before | | After | | |
|---|---|---|---|---|---|---|
| *OSBD* | *Group* | *n* | *%* | *n* | *%* | *p-value* |
| Information seeking | Experimental | 8 | 25 | 2 | 6.3 | 0.034* |
| | Control | 0 | 0.0 | 0 | 0.0 | 1.000 |
| Crying | Experimental | 9 | 28.1 | 4 | 12.5 | 0.025* |
| | Control | 8 | 25 | 8 | 25 | 1.000 |
| Screaming | Experimental | 24 | 75 | 3 | 9.4 | <0.001* |
| | Control | 19 | 59.4 | 11 | 34.4 | 0.021* |
| Restraint | Experimental | 27 | 84.4 | 10 | 31.3 | <0.001* |
| | Control | 29 | 90.6 | 26 | 81.3 | 0.257 |
| Verbal resistance | Experimental | 14 | 43.8 | 4 | 12.5 | 0.002* |
| | Control | 9 | 28.1 | 8 | 25 | 0.796 |
| Emotional support | Experimental | 32 | 100 | 7 | 21.9 | <0.001* |
| | Control | 31 | 96.9 | 31 | 96.9 | 1.000 |
| Verbal pain | Experimental | 10 | 31.3 | 3 | 9.4 | 0.008* |
| | Control | 2 | 6.3 | 6 | 18.8 | 0.102 |
| Flail | Experimental | 24 | 75 | 2 | 6.3 | <0.001* |
| | Control | 22 | 68.8 | 10 | 31.3 | 0.001* |

*n*, number of children with ASD; OSBD, observational scale of behavioral distress; *Statistically significant $p < 0.05$; Wilcoxon Signed–Rank test

The use of this behavior technique came in accordance with previous studies that used this technique for behavior modification in children with ASD during dental treatment.[34]

We instructed guardians in both groups to read and explain both types of dental visual aids in Arabic to their children daily for a minimum period of four consecutive weeks. The reading period should be a minimum of 15 minutes daily to fully understand the visual aids. This interval was defined in the literature as the minimal time required to effectively modify any behavior in ASD children and assist them in learning a new skill.[35]

The OSBD of children in the first dental visit before receiving dental visual aids in both groups has shown high scores indicating children refusing dental treatment. These results aligned with studies that reported most children with ASD, had negative behavior during dental examinations.[29] This was explained by the unique behavioral patterns in children with ASD, and their resistance to changes in their daily routine.

Orellana et al. reported an increase in positive behavior during the dental appointment measured by the "Frankl scale",[13,17] for children in their research. This agrees with our results and could be explained by the repetition of training sessions in their program, which made children more familiar with the dental staff and more accepting of the dental appointment steps. Moreover, similarity of dental visual aids used in the present study with theirs.

**Table 2:** Comparison between OSBD before and after using the dental visual aids within each group

| | Experimental group | | | | | | Control group | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Before | | | After | | | Before | | | After | | |
| | *Mean* | *SD* | *MED* | *Mean* | *SD* | *MED* | *Mean* | *SD* | *MED* | *Mean* | *SD* | *MED* |
| OSBD | 4.625 | 1.518 | 5.00 | 1.093 | 0.962 | 1.00 | 3.750 | 1.163 | 4.00 | 3.125 | 1.699 | 2.00 |
| *p*-value | <0.001* | | | | | | 0.077 | | | | | |

MED, median; OSBD, observational scale for behavioral distress; SD, standard deviation; *Statistically significant $p < 0.05$; Wilcoxon Signed–Rank test

**Table 3:** Comparison between the differences in OSBD before and after using the dental visual aids between groups

| | Experimental | | Control | | |
|---|---|---|---|---|---|
| *Group* | *Mean rank* | *Sum of ranks* | *Mean rank* | *Sum of ranks* | *p-value* |
| OSBD score | 20.42 | 653.50 | 44.58 | 1426.50 | <0.001* |

OSBD, observational scale for behavioral distress; *Statistically significant $p < 0.05$; Mann–Whitney test

Children with ASD in our present study were selected with no previous dental experiences as having previous traumatic experience might affect their ability to learn new routines interfere with the acquisition of new skills proposed in the dental visual aids and affect their behavior negatively. This selection was made following a previous study by Zink et al.[32]

Children in the present study had mild to moderate ASD according to CARS.[20] This is because children with mild ASD can speak few words and are able to make a simple order, while those diagnosed with moderate ASD can speak single words and are not able to have mutual communication however can somehow comply with short simple orders given by the dentist.[33]

In the present study, the behavior technique used in both groups was TSD; this is because these children had mild to moderate ASD and could understand simple short orders from the dentist.

The behavior of children with ASD was assessed by Mah and Tsang,[15] using an observational system called "The child–adult medical procedure interaction scale–short form" (CAMPIS–SF).[35] They found that scores decreased significantly in those who received dental visual aids in the form of pictures, which agreed with our results. This may be due to the similarity of behavioral distress signs observed in their study "screaming" and "crying", which is similar to our scale.[21]

Zink et al.,[32] reported similar results in their study which agreed with ours, they reported a lower number of attempts to acquire the skill proposed in each picture which indicated behavior improvement in children with ASD, which might be due to the similarity in the picture dental visual aids version used, and preference of child with ASD to communicate visually rather than verbally. Moreover, the presence of previous traumatic dental experiences could have affected the acquisition of new skills for those who did not improve their behavior.

Furthermore, Murshid[27] conducted a study in 2017 on children with ASD to assess their behavior during their first dental visit, after training with a storybook using the Frankl behavior rating scale.[17] Murshid recruited children with ASD with no past dental experience and found a statistically significant positive effect on their behavior in their first dental appointment, where they reported that almost half of the children in their study had a positive behavior rating during their first dental appointment (47.5%), which coincides

with results in our present study. This could be explained by the preference for visual communication in children with ASD over verbal communication. Moreover, the absence of a previous dental experience in their study and our present study might have helped the children build new skills without the negative effect of a past traumatic experience.

Another study in 2017 that assessed behavior in children with ASD by Nilchian et al.,[28] used the Frankl behavior rating scale for their assessment.[17] They reported that children with ASD showed significant improvement in behavior in both groups in their study, although one group received dental visual aids, and the other group did not receive any dental visual aids. Their results did not come in line with our results, and this might be explained by the difference in the assessment method, as they assessed the behavior in the dental appointment steps in their study. They explained their results by reporting that the steps were very simple, using such commands as "enter the dental clinic", "sit in the chair", and "open your mouth", and required simple requests from the dentist, not requiring such extensive training to make children accepting and cooperative. However, on assessment of an actual dental procedure such as fluoride application, they found that the cooperation in the experimental group was significantly higher in comparison to the control group, where children in the control group did not show any improvement in behavior with the repetition of the dental visits. This part of the results agreed with the results in our current study, where the acceptance and high cooperation when performing fluoride application in the experimental group might be explained by the effectiveness of dental visual aids in training the child with ASD for more complicated dental procedures rather than simple requests, which might have allowed them to accept and learn new skills.

However, results from Zink et al.,[36] did not coincide with ours, they reported children had better outcomes when they measured the number of attempts that children required to achieve each dental step; this might be due to differences in assessment method of behavior as well as differences in the type of visual aid used (electronic version) which is more appealing to children. A systematic review analyzed studies in the literature on behavior management of children with ASD in the dental clinic and concluded that all studies included in the review had successful outcomes.[37]

We recommend the use of culturally adapted dental visual aids as a behavior management technique prior to the dental appointment in order to prepare the child with ASD for the dental appointment. The limitation of this study was the exclusion of children with severe ASD. Future research including electronic versions of the culturally adapted dental visual aids is recommended.

## Conclusion

The OSBD total score was lower in the experimental group after using the aids than in the control group, our culturally adapted dental visual aids were effective in improving behavior during dental treatment.

### Clinical Significance

By evaluating the impact of culturally adapted visual aids on behavior management, the study can enhance the accessibility and effectiveness of dental care for this vulnerable population, ultimately promoting better oral health outcomes and reducing potential trauma associated with dental visits for children with ASD.

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