

Behavioral Guidance Approaches to Provide Dental Care for Patients with Autism Spectrum Disorder: A Review of the Literature

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Abstract

Autism Spectrum Disorder (ASD) is a condition with a specific neuropsychological and sensory profile that complicates dental procedures. Consequently, most of these patients are treated under general anesthesia or unnecessary sedation. Contemporary and/or alternative educational and behavioral approaches may facilitate successful dental care for these patients. A literature review was conducted for relevant information on basic and alternative behavioral approaches for dental care of children with ASD. Basic educational approaches used for neurotypical children can be applied in the dental setting for ASD children. Examples include communication guidance, non-verbal communication, Tell-Show-Do (TSD), voice control, positive reinforcement and descriptive praise, distraction, contingent and non-contingent escape, parental presence/absence, modeling, and desensitization. Additionally, customized behavior guidance plans can be adapted for children with ASD including sensory adapted dental environment (SADE), animal assisted intervention (AAI), picture exchange communication systems (PECS), social stories, or video modeling in advance of the appointment, breaking down dental treatment into sequential components, and modification of the environment to minimize sensory triggers. A review of the published articles on ASD in dentistry reveals that upon understanding of children with ASD as individuals and applying contemporary principles of education and behavioral approaches; most of these patients can be provided with optimal oral health care.

Keywords: Autism; Dental Care; Behavioral Management; Dental Strategies; Dental Techniques; Dental Management

Abbreviations

ASD: Autism Spectrum Disorder; SADE: Sensory Adapted Dental Environment; AAI: Animal Assisted Intervention; PECS: Picture Exchange Communication Systems; DSM: Diagnostic and Statistical Manual of Mental Disorders; PDD: Pervasive Developmental Disorder; ABA: Applied Behavior Analysis; SI: Sensory Integration; BGTs: Behavior Guidance Techniques; TSD: Tell-Show-Do; TEACCH: Treatment and Education of Autistic and Related Communication-Handicapped Children; FTB: First-Then Board; AAT: Animal-Assisted Therapy

Introduction

ASDs are a set of lifelong neurodevelopmental disorders defined by a significant impairment in social interaction and communication with the presence of unusual, repetitive, and stereotyped behaviors. The learning abilities of individuals with

ASD can vary from gifted to severely challenged and they are diagnosed during early childhood, with symptoms becoming established by age two or three years. ASDs are affecting all racial, ethnic, and socioeconomic groups and are four times more likely to occur in boys than girls.

In 2013, the Diagnostic and Statistical Manual of Mental Disorders-5th edition (DSM-5) was published (Table 1), updating the diagnostic criteria for ASD from the previous 4th edition (DSM-IV) [1,2]. In DSM-5, the concept of a "spectrum" ASD diagnosis was created, combining the DSM-IV's separate pervasive developmental disorder (PDD) diagnoses: autistic disorder, Asperger's disorder, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified (PDD-NOS), into one [1]. Rett syndrome is no longer included under ASD in DSM-5 as it is considered a discrete neurological disorder.

Changes	DSM-IV	DSM-5
Location in Manual	First diagnosed in infancy	Neurodevelopmental disorder
Sub-Criteria	<p>Three sub-criteria</p> <p>Qualitative impairment in social interaction</p> <p>Qualitative impairment in communication</p> <p>Restricted repetitive and stereotyped pattern of behavior, interests, and activities</p>	<p>2 sub-criteria</p> <p>Persistent deficits social communication and social interaction</p> <p>Restricted repetitive and stereotyped pattern of behavior, interests, and activities</p>
Needed for Diagnosis	Triad: 3/3 diagnostic criteria must be met	Dyad: 2/2 diagnostic criteria must be met
Diagnostic Criteria	<p>Qualitative impairment in social interaction, manifested by at least two of the following:</p> <p>Marked impairment in multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, and gestures regulating social interaction</p> <p>Failure of peer relationship development</p> <p>Lack of spontaneous seeking to share enjoyment, or interests with other people</p> <p>Lack of social or emotional reciprocity</p> <p>Qualitative impairments in communication as manifested by at least one of the following:</p> <p>Delayed development of spoken language or total lack of it.</p> <p>In individuals with adequate speech, marked impairment in initiating or sustaining a conversation with others.</p> <p>Stereotyped and repetitive use of language</p> <p>Lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level</p> <p>Restricted repetitive and stereotyped patterns of behavior, interests and activities, manifested by at least one of the following:</p> <p>Encompassing preoccupation with one or more stereotyped patterns of interest that is abnormal either in intensity or focus</p> <p>Apparently inflexible adherence to specific, nonfunctional routines or rituals</p> <p>Stereotyped and repetitive motor mannerisms</p> <p>Persistent preoccupation with parts of object</p>	<p>Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following:</p> <p>Deficits in social-emotional reciprocity, (including abnormal social approach and failure of reciprocal conversation, reduced sharing of interests, emotions or affect, failure to initiate or respond to social interactions)</p> <p>Deficits in nonverbal communicative behaviors used for social interaction (poorly integrated verbal and nonverbal communication, eye contact and gesture/body language abnormalities</p> <p>Deficits in developing, maintain, and understand relationships (including adjusting behavior in various social contexts, difficulties in sharing imaginative play or in making friends, or lack of interest in peers)</p> <p>Restricted, repetitive patterns of behavior, interest, or activities, manifested by at least two of the following:</p> <p>Stereotyped or repetitive motor movements, use of objects or speech</p> <p>Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior</p> <p>Highly restricted, fixated interests that are abnormal in intensity of focus</p> <p>Hyper- or hypo reactivity to sensory input or unusual interest in sensory aspects of the environment</p>

Age of Development	Onset prior to age 3 years	Symptoms must be present in early development period but may not manifest until social demands exceed limited capacities or may be masked by learned strategies
Not Better Explained by	Rett’s disorder or childhood disintegrative disorder	Social (pragmatic) communication disorder (SPCD)
Sensory Symptoms	Not addressed	Sensory symptoms are a new criterion introduced in DSM-5 under the sub-criteria of restricted, repetitive patterns of behavior, interests, or activities

Table 1: Updated diagnostic criteria for ASD from the previous 4th edition (DSM-IV) to (DSM-5).

Patients with ASD have dental needs like those of any other patients, however their needs are not usually met. As research showed, 8-12% of children with ASD have unmet dental needs compared to approximately 5% of typically developing peers [3].

The limitation of dental treatment of ASD patients is mainly attributed to the presence of multiple barriers, including those met by their typically developing peers, such as uncooperative behavior, cost, and lack of insurance [3]. Additionally, ASD patients have atypical behaviors and sensitivities that jeopardize dental treatment and turn it into one of the most difficult types of health care received. One of the most challenging barriers is what is known as “sensory processing disorder”; a disorder affecting the way the nervous system processes and responds to different stimuli received by the five senses. As a result, patients might display atypical “fight or flight” behaviors or responding aggressively when they are overwhelmed by sensations. Fight or flight behavior appears as an attempt to escape from the distressing stimuli; if escape is not possible, the individual will become physically reactive to remove himself or herself from the input. Avoidance responses may escalate to physical aggression ranging from gaze aversion, physical withdrawal or hiding, pulling away, crying, blocking of the stimuli with arms or hands (i.e., covering ears or eyes), and vocal outbursts. More extreme behaviors can include hitting, kicking, biting, pushing, tantrums, severe gagging, and vomiting [4,5].

Moreover, there are a range of individual and environmental factors that participate in the elevated risk of poor oral hygiene of children with autism [5]. Among these factors are limited manual dexterity of children with autism to perform daily brushing and offering comfort food by parents to calm their children. Most of these foods contain carbohydrates and other sticky foods which

increase susceptibility and progression of carious lesions. Thus, due to the various risk factors, patients with autism require special management in the dental clinic.

Basic and advanced behavioral management techniques used in pediatric dentistry can be applied to patients with ASD, according to the same contraindications considered for children without ASD [5]. However, social communication impairment, which is a character of ASD, might alter the usual behavioral approaches that focus on positive interactions between patients and dental team [4].

The Centers for Disease Control and Prevention and National Research Council advocate education of ASD children that focuses upon development of social skills, language, motor skills, and proper behavior [6]. Among the recommended teaching methodologies that can be adapted in the dental setting are, applied behavior analysis (ABA), structured teaching, speech and language therapy, social skills instruction, occupational therapy, and sensory integration (SI) therapy [7]. ABA therapy works through analysis of the relationship between a child’s behavior and his or her environment. Afterwards, practitioners develop systems and structures to reinforce desired behaviors and gradually change undesirable behaviors or responses to stimuli. Contemporary dental behavior management strategies have begun employing the same learning model used in educational setting of patients with ASD.

The aim of this review is to provide a thorough search on the basic and alternative behavioral guidance techniques used for ASD patients in dental clinic (Table 2).

Basic Behavioral Guidance Approaches	Alternative Behavioral Guidance Approaches
Nonverbal Communication	Sensory Adapted Environment
Tell-Show-Do	Sensory Integration
Voice Control	Applied Behavior Analysis
Positive Reinforcement and Descriptive Praise	Visual Pedagogy/ Social Stories, TEACCH, PECS
Distraction	Video Modeling and Virtual Reality
Contingent Escape	Animal Assisted Intervention
Non-Contingent Escape	
Parental Presence/Absence	
Systematic Desensitization	
Consistency	
Escape Extinction	

Table 2: A summary of basic and alternative behavioral guidance approaches used for ASD patients in dental clinic.

Materials and Methods

This article summarizes the different strategies used in dental clinics to treat patients with ASD. Relevant studies published in the period from 1969 to 2022 were reviewed and the search was carried out in the main databases, “PubMed”, “MedLine”, “Science Direct”, “Cochrane Database”, and “Google Scholar”. The following key words: autism, dental care, behavioral management, dental strategies, dental techniques, dental management, and autism were used.

Results and Discussion

Contemporary/Basic Dental Behavior Management Strategies

Thorough knowledge of basic behavior guidance techniques (BGTs) is crucial to successfully manage children with ASD in the dental setting. Most notably, patients with ASD display a broad variety of abilities and performance and respond inversely to different management strategies. A tailored dental treatment approach is recommended rather than generalized treatment options.

BGTs were successfully used to provide dental care for children with ASD. A successful clinical examination was achieved on the

first attempt for 50% of a group of ASD patients [8] using BGTs such as, positive reinforcement, TSD, and negative reinforcement.

A survey and chart review were conducted for a group of 43 patients with ASD [9]. Commonly used communications techniques were used to provide simple dental treatment in the traditional dental setting.

Recent literature reviews reported various dental strategies and behavior management techniques to manage children with ASD such as, positive reinforcement, systematic desensitization and TSD techniques [4,5,10].

A systematic review published in 2021 identified a range of strategies in providing dental treatment to children with autism, including desensitization, educational strategies (e.g., inter-professional collaboration), behavioral strategies and local anesthesia [11]. Examples of the BGTs commonly used to support patients’ behavior

Nonverbal communication

Describes body language postural changes, hand gestures, eye contact, physical touch and facial expression as a mean of communication rather than spoken language [12,13].

For persons with ASD, nonverbal communication might be the primary mean of sensing and reading the intentions of others. Taking into consideration that autistic individuals exhibit minimal use and comprehension of language and inability to follow multistep instructions. Many of these patients might benefit from gestures or visual aids. It is necessary to use a visual support and schedule, sensory distraction (redirecting attention), and to rely on the assistance of the parent/caregiver. However, crossing into personal space of these patient must be measured and initiated at the right moment. On the other hand, ASD patients might not be able to clearly “read” nonverbal communication. Thus, prior to utilizing nonverbal communication guidance, the functional level of the ASD patient must be assessed [14].

TSD

TSD is a basic, effective exposure therapy to introduce dental procedures, instruments, or equipment to a patient. Patients with ASD benefit tremendously from the TSD as a method of

communication guidance. Modifications to the approach are required by adding sensory demonstration cues - visual [15], auditory, touch, proprioception, taste/smell - to a simple verbal description of a procedure prior to performance of this procedure [12].

For individuals with limited language, "Foreshadowing" and "Visualization" are concepts that use positive images, guided relaxation, and measured play to explain to the patient what to expect during new procedures. Positive reinforcement throughout the TSD approach must be constantly provided, regardless of the patient's cooperation. This method of behavior guidance might need to be practiced frequently before the actual procedure; thus, the positive reinforcement is used to continue to progress in the process [12].

The objectives of TSD are to shape the patient's response to dental procedures through desensitization. Demonstrating materials from the dental office prior to the visit by the parents/caregiver at home, might introduce the patients to unfamiliar products used in a familiar environment (the home) [14].

Voice control

Describes gaining the patient's attention and changing behavioral direction by alterations of vocal volume, pace, and intonation [12]. Although persons with ASD may not typically comprehend language, but they can quite sense the mood of others during interactions. Using a single voice to communicate with the patient might be beneficial especially if the patient is unable to process duplicative input that might cause further disruption.

As suggested by current cultural trends, disciplinary forms of behavior management strategies like voice control, are losing societal acceptance. Therefore, before using this technique, the parent/caregiver must be informed of the use of voice control, to avoid any confusions during treatment. The aim of the technique is to rise cooperation and attention while lessening any negative behaviors. Although voice control can be used with any ASD patient, however those with hearing disorders are not good candidate for this technique [14].

Positive reinforcement and descriptive praise

Positive reinforcement is rewarding the desired behavior with verbal praise, expression, touch or tokens. As a result,

the reinforced behaviors should increase [13]. Recognition of achievement in dental setting creates self-esteem and coping skills that will transfer to the next appointments [16]. Descriptive praise emphasizes specific cooperative behaviors (e.g., "Thank you for sitting still") rather than a generalized praise (e.g., "Good job"). Reinforcers could be social, include positive voice modulation, facial expression, verbal praise, and appropriate physical demonstrations of affection. On the other hand, nonsocial reinforcers could be in the form of tokens and toys.

ASD patient's cooperation can be greatly enhanced with positive reinforcement in the form of constant positive reinforcers, immediate verbal praise after each step of a procedure and a reward at the end of a dental session.

Distraction

Describes diverting a patient's mental focus or attention from inappropriate behaviors or procedures to positive thoughts, favorable environmental stimuli, or other stimulating sensory images. Focusing on the positive aspects of something aids in soothing ASD patients. Subsequently, overriding of unpleasant procedures and redirection of negative behaviors are expected [14]. However, if sensory overload is an issue for the patient, a nonstimulant environment will be the ideal setting. All forms of distractions should be eliminated and counting on a calm "single voice" to direct behavior through treatment should be done.

There are several forms of distraction, passive one such as pleasant sounds and smells, TV/videos, virtual reality eyeglasses or visual artwork that provide a calming environment. On the other hand, active distraction such as simply counting aloud, requires the patient to focus on a mental task during the negative activity. While Imagery distraction by storytelling, is a reminder of an approaching rest period that might divert attention.

Another form of distraction, which is of great value for children with ASD, is physical sensory distraction, such as using a leaded x-ray apron, weighted blankets, or stabilization wraps [17,18].

It was reported in various studies that applying firm wrap, pressure, and/or touch on oversensitive persons might have a positive calming and soothing effect.

In the context of self-injurious behaviors, Lindemann [19] considered physical restraint and found out that some ASD children can be comforted by using it.

A review of literature by Grandin [20] on deep touch pressure applied to patients with ASD and Attention Deficiency and Hyperactive Disorder or ADHD, reported a relaxing and calming effect of deep pressure observed by occupational therapists, whereas Grandin's light pat can be a tonic to the nervous system.

On mentally challenged patients, the use of various physical restraints was reviewed and guaranteed safer working setting and predictable patient's response [21].

Patients with ASD who are experiencing deficiency in expressive and receptive language, may not be as amenable to the BGTs, including "positive reinforcement, TSD, distraction methods, non-verbal communication, and voice control" [4]. Therefore, those patients should be recognized as unique individuals taking into consideration their diverse abilities and temperaments. In order to successfully support patient's behavior, adaptation of communicative techniques, moderate office routine, and altered office environment must be considered [12].

Contingent escape

Describes momentary cessation in treatment that is conditional upon periods of appropriate behavior [12,22]. In this technique, escape will be a rest period from the stimuli or the dental procedure. The rest period is earned (contingent) upon completion of a desired behavior, which is an acceptable amount of tolerance of the provided procedure. Giving the patient a short break during a stressful procedure is used as a positive reinforcement and as an effective method of active distraction as well. The use of contingent distraction can be beneficial, as the child knows exactly how long the intervention will take.

Noncontingent escape

A technique that provides break from demands or procedures in relation to a specified period of time; it is not dependent or contingent upon patient's compliance or tolerance. To simplify, the break is not "earned", but the patient's tolerance of treatment is still rewarded regardless of behavior. For example, counting aloud (distraction) as a promise that "we're going to rest in one, two...

etc.", at the same time provision of care is gradually provided (22). Noncontingent escape has been described of benefits for children with crying, movement, tantrums, and other disruptive behaviors.

Parental presence/absence

It is utilizing the parent to increase patient psychological comfort and reduce anxiety. Patients with ASD are capable of enduring procedures that are expected and predictable, however, their parents might present many possible emotions or concerns that might affect interaction with the patients or even their treatment [12]. Thus, the family's trust should be gained initially by demonstration of a caring and skillful approach. Parents should understand and consent to advanced or difficult behavioral support techniques or refuse the treatment approach. It should be made clear that the dentist is the primary communicator with the child when the parents are present in the clinic. Parents should remain silent as much as possible, or should limit discussion to non-procedural topics, and resist expression of fear as much as possible. Anticipating potential obstacles and subsequently make the necessary accommodations to facilitate the dental appointment, can be achieved by discussing the procedures ahead of time. A pre-visit questionnaire can be used to enable information intake; this includes personal medical information, oral habits, communication, behavior, vision, hearing, sensory sensitivities, and a thorough record of the patient's previous medical and dental services [12].

Systematic desensitization

Defined as gradual exposure of the patient to a stimulus, feared object or situation, with the concurrent training and reinforcement of relaxation [13]. It is a psychological technique that has been successfully applied to modify behavior of anxious patients in the dental office. Patients are gradually exposed to stimuli that cause them anxiety over a series of therapy session. Following habituation and successful approximations, patients will be able to proceed with dental care in a relatively comfortable state.

Learning in short bursts that are delivered incrementally is more likely to be retained with ASD children. Thus, treatment programs employing desensitization and exposure approaches have demonstrated marked success with them. Stepwise approach was advocated by Swallow [23] through careful and slow repetition of tasks which enabled dental procedures on even the most severely affected patients.

Kopel [24] suggested dividing dental procedures into smaller steps with rehearsals at home prior to the dental appointment in order to familiarize the child with basic dental instruments and procedures.

Luscre and Center [25] described desensitization with guided mastery, symbolic video peer modeling, and reinforcement in children with ASD. It was found that severely delayed individuals with ASD can be qualified to participate in upsetting, fear-provoking procedures.

Unfortunately, dental care therapy often involves aversive and intrusive stimuli and always involves violation of personal space. Therefore, when an aversive stimulus is unavoidably necessary as part of a procedure, positive attention to the patient should be provided immediately after completion of the procedure. Individualized reinforcements that are meaningful to the patient and encourage desired behaviors could be on a primary level (e.g., food, money) or on a secondary level (e.g., praise, recreation) [5].

Desired behaviors should be reinforced immediately, and the dentist should consider the use of unconventional reinforcers that might be used in other aspects of the child's life, such as a special outing or access to movies and video games [4].

The amount of time and number of visits required for each patient may vary considerably, from 10 minutes to 2 hours per session, with up to 10-12 visits total.

Although systematic desensitization has a high success rate, the generalizability of the success has been questioned. A patient's learned skill might be limited to a certain environment and provider. Moreover, severely affected person might be less amenable to desensitization; it is preferable to be accustomed to using these techniques in other areas of their education. Not to mention the time required for desensitization training which makes it uncommon routine in dental setting.

Consistency

A message that is inconsistently delivered might be confusing to the patients. Thus, a message should be repeatedly presented in simple and consistent fashion in order to provide a familiar environment for patients with developmental disorders [5]. Examples of environment familiarity are, the same operator,

dental chair, color of bib, flavor of polishing paste, assistant or even the same favorite toy being present during treatment. It is crucial to limit changes of place and routine to extreme necessity [5].

Escape extinction

Escape extinction describes the counterintuitive psychological approach that in order to overcome fear, an individual must face that fear. Disruptive behavior of the patient that results in termination of (escape from) treatment, might reinforce resistive behavior and consequently delay the needed care [13].

Escape extinction could be done utilizing medical stabilization and physical guidance to provide needed treatment. Whereas, it could be simply by saying the word "no" when appropriate, or it may involve repeated verbal or physical prompting to terminate or redirect escape behavior. Even when a practitioner decided that it may not be possible to follow the treatment plan because of the behavior, the patient must never perceive that his/her behavior is the reason of the treatment termination. Treatment termination should be presented only as the operator's choice and with positive reinforcement to the patient for his tolerance up to this stage [13].

Alternative behavior strategies

Describe strategies for accommodating atypical behaviors of children that are not normally considered within the confines of dental daily practice. Review of literature addressed alternative behavioral control strategies used by dentists to treat patients with ASD (4,10) such as TEACCH (Treatment and Education of Autistic and Related Communication-Handicapped Children), ABA, The Picture Exchange Communication System (PECS), and the Son Rise program.

Sensory adapted dental environment (SADE)

Individuals with ASD might suffer from sensory processing difficulties such as sensory defensiveness, which is a behavioral overreaction to or extreme avoidance of common sensory experiences that are often tolerated by others. Depending on the received stimuli and the amount of exposure the overreactions would range from mild to severe.

Multiple sensory impairments can occur in any of the seven sensory systems: tactile (touch), vestibular (sense of movement in relation to gravity), auditory (sound), visual (sight), proprioceptive

(position of body parts, joints, and muscles as well as the amount of force being used with movement), gustatory (taste), and olfactory (smell).

In most of the cases, the neurological system of these individuals is unable to balance these senses appropriately and filter stimuli, which results in overwhelming amounts of sensory input. Thus, in dental office, creating an atmosphere that will integrate the impact of these senses might aid in coping with invasive dental procedures [26,27].

Based on sensory integration theory and multisensory environments information, environmental changes could be as simple as using quiet and separate room with subdued lighting, relaxing music, or even running water. These changes have shown to minimize stimuli and to decrease anxiety [4,26,27]. Additionally, watching a video to serve as a distractor [18] and the noise reduction in the dental drill as well might efficiently aid in reducing the anxiety presented by ASD children [27].

Other environmental changes that are more elaborate and expensive technologies, like Snoezelen or controlled multisensory environment, have also been shown to be helpful in reducing anxiety, increasing motivation to succeed, and improving co-ordination and concentration in individuals with sensory impairments. Snoezelen is used to adapt the lighting, sounds, and textures to the specific needs of the patient providing a multisensory experience. It has been used successfully in hospital-based environment [28].

Cermak SA [17] conducted a randomized controlled pilot and feasibility trial examining the impact of SADE to enhance oral care for children with ASD. SADE was found feasible to implement and potential to reduce pain, anxiety, sensory discomfort, behavioral distress, and physiological stress.

Another pilot and feasibility study conducted by Cermak, *et al.* [26] examined the influence of a SADE to reduce distress, sensory discomfort, and perception of pain during oral prophylaxis for children with ASD. A decreased physiological anxiety, lower pain, and sensory discomfort were reported in the SADE condition.

A recent study conducted by Fallea, *et al.* [27] aimed to assess the efficacy of a SADE on reducing anxiety and positively influencing cooperation in ASD children. It was concluded that a

SADE can positively affect dental treatment in children with ASD, thus restating that sensory disorders are critically influencing the outcome of oral care.

SI

ASD persons with sensory processing impairment are unable to integrate information across a variety of contexts (perception, attention, linguistic and semantic). Many theories attempted to explain the exact mechanism by which this occurs; however, all implicate atypical sensory processing as a core element. For example, individuals with hypo sensation might feel less pain and enjoy sensations like strong tastes or intense pressure, on the contrary, those with hyper sensation might react intensely to minimal touch, taste, or sound. A combination of these two kinds of sensory impairments could occur in the same person.

Using both remedial and compensatory intervention strategies managed by occupational therapy practitioners could help ASD children with these difficulties to function better and participate more fully at home, in school, and in their communities. One of the remedial approaches that is designed to improve children's SI functioning is Ayres Sensory Integration® (ASI) intervention; it involves intensive, individualized occupational therapy sessions [29]. Another approach is Castillo Morales® Concept which assumes that providing intense input for a sense allows the individual to tolerate further stimulation [30]. For example, applying intense deep pressure for an individual with hyposensitivity to touch who does not like to have his/her teeth brushed might be beneficial. Firstly, applying firm pressure should be on the extremities; then to the forehead, next to the eye area, cheeks, then to the chin area, lastly proceed intraorally. Most parents will be aware of what comforts their child, however, the relationship between daily oral care and sensory impairments may not be understood by the parents. Explaining the impact and methods of intervening to the parents will establish long-term and efficient oral health goals.

ABA

ABA is an evidence-based treatment that is accepted by the American Academy of Pediatrics in the management of ASD. It implies changing in behavior by analyzing antecedents of behavior and consequences that follow [7].

The application of ABA practices in dentistry could be used to improve the outcome of the conventional BGTs and to consequently

decrease the need for intrusive procedures, such as restraints and sedation.

As a component in the desensitization model that is based on task analysis; a specific task (desired behavior) is broken down into incremental components [7,22]. Each component of this skill would be taught separately, and a child would be rewarded as they master each skill [7,13].

Initiation and termination of the stimulus are associated with the positive and negative reinforcements respectively. Positive reinforcer such as rewarding with a toy or praising might enhance compliance in the dental chair. On the contrary, negative reinforcer such as dental drilling can be managed by keeping the procedure for a predetermined period for example, counting from 1 to 10. Cessation of the procedure should be followed immediately, and the sequence of these events should be repeated as long as needed to complete the procedure.

One of the behavior methodologies based on ABA is the D-TERMINED Program of Familiarization and Repetitive Tasking [22]. The program recognizes the most important factor in being successful with behavior challenges is to be DETERMINED.

Three repetition factors are the keys to success in this behavior guidance technique, with the use of verbal commands in a reinforcing manner: (1) Eye contact (reminding the patient to look at me frequently through the visit) (2) Positional modeling (positioning and holding the legs out straight and hands on the stomach for a 10 second count) and a (3) Counting framework (verbally and repeatedly count to 10 during a procedure and always completing the procedure within this time).

A retrospective data analysis [22] was performed to compare the effectiveness of the D-TERMINED Program and BGTs. Based on the results of this study, it was found that the D-TERMINED program may help the children with ASD to gain the cooperation skills needed in dental practice and consequently decrease the need for operation room referrals.

Visual pedagogy, social stories-TEACCH and PECS

Visual pedagogy and social stories

Based on the ability of children on the ASD to respond better to pictures rather than to words, a variety of non-traditional

approach to behavior guidance emerged such as visual pedagogy. The approach includes the use of books with color photographs, social stories, or video modeling in combination with traditional BGTs. To increase patient's comprehension and compliance, it may be beneficial to use the first-then board (FTB) method with visual schedule. FTB is a fundamental language base that provides step-by-step visual instructions and ordering of upcoming events. The "first" picture is characteristically an activity to build a skill needed to be performed whereas the "then" activity includes a reward for the patient that symbolizes an exchange for his/her compliance.

In a previous study using visual pedagogy on 14 children with ASD (5-13 years, mean age = 9.3 years), maintaining oral hygiene became easier on most parents after 18 months of the study. Thus, it was considered as useful tool to improve oral hygiene of their children with ASD [31].

In a different study, a series of pictures that showed a structured method and technique of tooth brushing were used in the bathroom, at home and/or at the autism center [32]. A statistically significant change in oral hygiene index and plaque index scores were observed.

A systematic review was designed and carried out to assess whether visual pedagogy is an effective tool for oral hygiene children with ASDs [33].

Visual pedagogy is effective in improving and maintaining good oral health in patients with ASDs, as revealed by improvement of plaque index and gingival index in all the studies performing this evaluation. In addition, an increased cooperation of children was seen in almost all studies investigating behavior during dental care.

A blinded, randomized, controlled clinical trial was conducted to assess the effectiveness of culturally adapted dental visual aids in improving oral hygiene status in children with ASD [33]. Both culturally adapted dental visual aids and regular dental visual aids were effective in improving the oral hygiene status with a significant improvement in the group that used the culturally adapted dental visual aids.

Visual pedagogy has been used for the development of social stories; a widely used strategy for ASD children that initially developed by the special education teacher Carol Gray.

A social story is a description of a situation, social skill, or concept that children find challenging in a simplified way, using social cues, perspective, and common responses in a specifically defined style and format [5].

This approach is commonly used by parents of ASD; thus, they can provide pictures and scenarios of the staff and the environment that the person will experience. They can be created by the parents or by the office, they could be in the form of PowerPoint presentation or short video clip. Practitioners who seek to create a social story for a dental visit should review the guidelines associated with their formulation. These stories are typically short by design and rely on a ratio of descriptive, perspective and/or affirmative sentences, in addition to visual cues [5].

One of the uses of these stories is in desensitization of the patients by pre-visit preparation at home together with repeated dental visits allowing them to see and touch equipment that will be used during their treatment [4]. These stories provide positive narrative of the upcoming dental experience in addition to information regarding home based oral care, preparation of the child before coming to the dental clinic, and various images and videos. The use of social stories was effective in increasing understanding of dental treatment by parents, and they impacted positively on the child's behavior.

TEACCH®

TEACCH® technique or Treatment and Education of Autistic and related Communication-handicapped Children, developed by Mesibov and Schopler [35], is a technique that provides cue cards with a precise breakdown of a procedure ahead of time. These visual schedules are utilized to make expectations clear and explicit. Most patients with ASD present behavioral problems and daily stress because of communication deficits, poor understanding of social cues and the difficulty of generalization. These challenges can be enhanced by using the pedagogic strategies based on TEACCH principles through visual organization of the environment by visual stimuli or set of signals. It is a technique that helps in keeping the individuals focused, allowing them to be aware of upcoming activities and reducing their level of stress and anxiety.

The TEACCH method emphasizes structure, and it was known as "structured teaching" which is based on the neuropsychological

profile of people with ASD and is reliant on the temporal and spatial organization of visual information. The important elements of structured teaching include organization of the physical environment, predictable sequence of activities, visual schedules, routines with flexibility, structured work/activity systems, and visually structured activities.

In a controlled trial, Ozonoff and Cathcart [36] found that ASD children who used a TEACCH-based home program for four months together with their local day treatment programs improved significantly in terms of cognitive, academic, and prevocational skills.

Tsang, *et al.* showed a significant improvement of motor skills and perception capacity of ASD children subjected to treatment with TEACCH [37].

Callahan, *et al.* compared between ABA and TEACCH, there was no clear preference for either of the methods found rather than a significant level of social validity for the components of both approaches [38].

Van Bourgondiën and Coonrod, [39] evaluated the efficacy of TEACCH 5-session training to facilitate oral evaluation of 10 different criteria in a group of 34 adults (19-41 years) and 38 children (4-9 years) with ASD. TEACCH was found to be an efficient method to complete the oral evaluation for adults and children.

Supporting the reliability of the TEACCH program as an evidence-based intervention, It was found that the TEACCH-based training program can be effective in facilitating a full dental assessment of children and adults with ASD, with and without intellectual disability [15].

(PECS)® and Mobile Application

Picture Exchange Communication System (PECS)®, based on the principles of applied behavior analysis and developed in 1985, is a unique augmentative and alternative communication (AAC) system for nonverbal children with ASD. PECS is a behaviorally based pictorial communication system in which children are taught to approach and give a picture of a desired item to a communicative partner in exchange for that item. In other words, the child initiates a communicative act for an item within a social context [40]. In the PECS program, reinforcement, delay, and generalization across

trainers and settings are used to shape expressive abilities of nonverbal ASD children through six distinct phases. The 6 phases of training are, how to communicate, distance and persistence, picture discrimination, sentence structure, answering questions, and commenting.

One of the sensory based interventions used with ASD children, is mobile application. It is an application designed for smart phones using a flexible software design. It aims at supporting social skills and life skills by encouraging calm, rational behavior in situations likely to induce high levels of anxiety.

PECS has been widely used in clinical and social settings for ASD children since it is relatively simple to use and teach, inexpensive and thus, it is expected to be a promising intervention.

A recent study presented an adaptation of ASD patients to preventive dental procedures in an outpatient environment using PECS approach without the need for physical restraint [40]. The Son-Rise Program® principles were followed with a main purpose to seek visual contact with the patients. Although the sample size was small, and a long time was needed for patients to accept the method, the results showed an increase in the visual contact and social interaction with the dentist. The Son Rise program was developed in the 1970's at the Autism Treatment Center of America, in the United States. The objective of the Son Rise method is to enhance the functional communication skills and language development by establishing an individual relationship between an adult and a child with ASD, and the adult is requested to prioritize the interests of the child in order to gain his confidence.

In another study aimed at assessing the effect of a PECS-based tooth-brushing program on gingival health in children with ASD [41], although PECS was rated as hard, it was useful in improving gingival health in children with ASD.

An interventional parallel arm study [42] consisting of 13- to 17-year-old school going adolescent with ASD aimed to evaluate the effectiveness of two sensory-based interventions namely - Visual pedagogy using cards and Mobile based application (Brush Up) on oral health education. There was a statistically significant reduction in mean plaque and gingival scores seen within both groups, however there was no difference in scores between the groups. Therefore, both modalities were found to be useful in improving their oral hygiene.

Video modeling and virtual reality technology

Video modeling is an alternative visual pedagogy-based method for children with ASD due to the growing tendency of electronic screen media use by them. This approach is an effective strategy for education of children with ASD; the visual nature of video modeling aids in finding the right frame of reference for behavior in a context. It might help as well in overcoming the inability to focus on a stimulus, and in compensating for hypersensitivity to stimuli in individuals with ASD [40].

ASD population favors visual stimulation, thus video peer modeling (viewing a procedure on a video) and visual supports are suggested by literature as an ideal educational tool for them.

A survey collected from caregivers of children with ASD indicated more interest of those children in watching television and video than using the computer, in addition to animated programming preferences versus non-animated. Video modeling approach using an animated character can gain the attention of ASD children because of their preference for animation together with the engagement in verbal and physical imitation while viewing electronic screen media [43].

Studies combining both picture cards and video technology supported the use of video technology for children with ASD [15].

Orellana, *et al.* incorporated both pictures and videos in a training program to attain a complete dental examination of children with ASD [15]. The video presented a model patient performing an oral assessment, 81.6% of the children participating in the program successfully presented cooperative behavior.

In another study, instructional video clips were implemented to express requests of children with ASD through the selection and retrieval of picture cards [44].

Literature that compared video modeling based toothbrushing to traditional social stories as an educational intervention for children with ASD favored video modeling over social stories [45-47].

Popple, *et al.* reported a significantly higher efficacy of teaching the correct brushing method and plaque removal in the video modeling technology compared to the traditional method of printed social story [46].

In consistent with these findings, Mohammadpour, *et al.* found that video modeling increased self-help skills, such as brushing skills, in ASD children at 1-month and 3-month follow-ups [45].

A recent quasi-randomized controlled trial compared social story based toothbrushing education versus video-modeling on oral hygiene status of a group of male students aged 7-15 years old with ASD [47]. It was concluded that tooth-brushing educational intervention using video modeling improved oral hygiene status more than traditional social stories.

Innovations in virtual reality technology contributed to the educational interventions for children with ASD. In one study, virtual reality simulations were compared to video technology [48], it was found that all strategies used were able to hold the attention of 6 to 18-year-olds with ASD, taking into considerations that virtual reality simulations gathered more vocalizations compared to traditional video viewing.

There could be a probability of anxiety reduction through mere distraction due to the overall engagement of virtual reality approach. Therefore, virtual reality programs can be utilized for distraction and relaxation during dental hygiene services and are suitable interventions for children with ASD.

AAI

AAI is integrating animals into therapeutic programming, it is comprised of three categories: targeted therapeutic services (Animal-Assisted Therapy, AAT), enrichment visits (Animal-Assisted Activities, AAA), and educational programs (Animal-Assisted Education, AAE).

AAT has been proved to be beneficial in dental environment. It is defined as a goal-oriented intervention that utilizes a trained animal in a healthcare setting to improve interactions or decrease a patient's anxiety, pain, or distress [16]. The animal used during the dental visit, can help break communication barriers and enable the patient to establish a safe and comforting relationship, thereby reducing treatment related stress. AAT is a promising intervention for ASD children that is highly supported by parents. The presence of animals may function as a social facilitator to connect individuals with autism to the people around them. Children with autism suffer from heightened social anxiety, bully, and rejection by their peers, therefore the presence of an animal may improve some feelings of

social stress by acting as a buffer and positive focus of attention. Recently, neurobiological evidence suggested that ASD children may perceive greater social reward from animal faces than from human faces, as indicated by greater activation in brain regions related to reward and emotional arousal such as the amygdala and putamen.

A recent systematic literature review was conducted [49] to analyze all empirical research on AAI for ASD published from 2012 to 2015. increased social interaction was the most reported outcome across 22 studies. Further research is needed to focus on refining AAI techniques to identify individuals who may not benefit in order to move AAI from an enrichment activity to an evidence-based practice for ASD.

Conclusion

ASD is one of the most common developmental disorders encountered in dental practice. Persons with ASD are faced with access-to-care barriers in part because of the intimidation of the health care provider or lack of knowledge about the treatment needs of these persons. Moreover, the daily life, oral health, and the ability to receive dental care are affected by the genetic, neurologic, sensory, and gastrointestinal nature associated with ASD. Thus, a dental visit can be a main source of stress for all individuals, including the child, caregiver, and provider.

Dental healthcare professionals should provide patience, collaboration, and an individualized approach for patients with autism and their caregivers. Treating the patients and their families with respect and dignity, seeing the patient as "different" rather than "disabled", will reflect positively on the patient and his/her parents or caregivers.

It is crucial to recognize that not all persons with a developmental disorder have an intellectual disability. Some individuals with ASD require nothing more than the customary practice routine. On the other hand, other individuals may require some assistance, and still others might depend on a third party for decisions or pharmacologic techniques for care.

However, as discussed above, dental practitioners can learn about the treatment accommodations considered for the ASD patients to deliver safe and effective oral health care to these

individuals. Through the application of a creative educational approach and taking the extra time to understand each child as an individual, the dentist will gain the trust and confidence of the child and his/her family. Consequently, preparing the child for a lifetime of positive dental visits.

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