Review
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Dental management and behavioral considerations in pediatric patients with attention-deficit/hyperactivity disorder: A narrative review

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Highlights

Children with ADHD face higher risk of caries, trauma, and bruxism due to behavioral challenges and medication side effects.

Effective dental care requires tailored strategies including short visits, simple instructions, and positive reinforcement.

Multidisciplinary collaboration among dentists, caregivers, and healthcare providers is essential for comprehensive care.

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Abstract

Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurodevelopmental condition that affected children's behavior, learning, and oral health. This narrative review aimed to synthesize current evidence on diagnostic considerations, comorbidities, behavioral manifestations, and dental management strategies in pediatric patients with ADHD. A structured electronic search was performed in PubMed/MEDLINE, Lilacs, BBO, and SciELO databases for English-language publications from 1971 to 2022. Of 145 records initially identified, 54 met the inclusion criteria. All studies were critically appraised by two independent reviewers to assess methodological rigor and relevance to pediatric dental practice. Children with ADHD were consistently reported to have an elevated risk of dental caries, traumatic dental injuries, and bruxism, largely attributable to behavioral challenges, poor oral hygiene practices, and side effects of stimulant medications. ADHD was also frequently associated with comorbid psychiatric and functional impairments that further complicated dental management. Effective care should be facilitated by short, well-timed appointments, simplified instructions, use of positive reinforcement, and coordination with caregivers and healthcare providers. A comprehensive understanding of the behavioral, medical, and pharmacological dimensions of ADHD is indispensable for pediatric dental practitioners. Individualized, multidisciplinary approaches are essential to optimize oral health outcomes and overall quality of life in children with ADHD.

Keywords: Attention-Deficit Hyperactivity Disorder; Behavior; Dental Management; Narrative Review; Oral Health; Pediatric Dentistry

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INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common mental health problems in children, with prevalence rates ranging from 2% to 9%.[1] Children with ADHD typically exhibit reduced sustained attention, impaired impulse control, and difficulties with activity modulation compared with their peers. These symptoms emerge early in life and often persist into adulthood. The condition is also sometimes referred to as attention deficit disorder (ADD). According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), ADHD is defined as a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development, with symptoms present in two or more settings (e.g., home, school, or social situations).[2] ADHD can negatively affect social, academic, and occupational performance.

The World Health Organization (WHO) refers to ADHD as hyperkinetic disorder (HD), although the diagnostic criteria are essentially the same.[3] ADHD/HD is among the most extensively studied childhood neurodevelopmental conditions and is associated with significant negative outcomes. These include a substantial financial burden on families and society, making ADHD a major public health concern. Common comorbid conditions include oppositional defiant disorder (ODD), conduct disorder (CD), emotional disorders, anxiety, and learning difficulties.[4-5]

This narrative review aims to critically evaluate and synthesize current evidence on the etiology, diagnosis, comorbidities, and dental management of children with ADHD, with the objective of guiding pediatric dental practitioners in providing effective and individualized care.

Background and Historical Perspectives

ADHD has been recognized for more than two centuries. In 1798, Sir Alexander Crichton described a condition resembling ADHD, which he termed *"mental restlessness"* and associated with heightened nervous sensitivity.[6] In 1902, George Still proposed that ADHD was a hereditary disorder distinct from poor upbringing. By the 1960s, Stella Chess introduced the term *"hyperactive child syndrome."* In 1980, the DSM-III adopted the designation *"attention deficit disorder (ADD),"* which was later revised to *"attention-deficit/hyperactivity disorder (ADHD)"* in 1987. The DSM-IV (1994) classified ADHD into three subtypes, while the DSM-5 (2013) introduced changes that allowed for co-diagnosis with autism spectrum disorder and acknowledged distinct presentations across the lifespan.[2]

While the clinical presentation and treatment of ADHD are well documented, the specific implications for pediatric dental care remain less thoroughly synthesized. This review seeks to consolidate current evidence on the etiology, diagnosis, and dental management of children with ADHD, while critically appraising the available literature.

METHODS

This narrative review adhered to the SANRA (Scale for the Assessment of Narrative Review Articles) criteria[7], ensuring a clear rationale, comprehensive literature search, methodological transparency, critical appraisal, and balanced interpretation of findings..

A systematic and structured literature search was conducted in accordance with SANRA and international best-practice recommendations for narrative reviews[7,8]. The databases PubMed/MEDLINE, LILACS, BBO, and SciELO were searched for articles published between January 1971 and December 2022. Keywords and MeSH terms included "ADHD," "etiology of ADHD," "diagnosis and treatment of ADHD," "behavior management of patients with ADHD," and "ADHD in children." Boolean

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operators (AND/OR) and truncation symbols were applied to refine the search, which was restricted to publications in English.

Eligible literature included narrative reviews, systematic reviews, meta-analyses, clinical trials, observational studies, consensus statements, and clinical guidelines involving children and adolescents diagnosed with ADHD. Studies addressing etiology, diagnosis, comorbidities, pharmacological and behavioral management, or dental implications were considered for inclusion. Publications in languages other than English, studies unrelated to pediatric populations, and those not addressing behavioral or dental aspects were excluded.

Two independent reviewers screened titles and abstracts for eligibility, followed by full-text assessment. Each of the 54 included publications underwent structured critical appraisal in accordance with SANRA and international narrative review standards. The appraisal process considered study design, sample size, methodology, clarity of outcomes, risk of bias, and reported limitations. Any discrepancies between reviewers were resolved through discussion until consensus was achieved.

From each eligible study, data were extracted on study type, participant demographics, intervention type, behavioral or dental outcomes, and conclusions. The findings were then thematically synthesized into sections addressing etiology, diagnosis and assessment, comorbidities, behavioral management, pharmacologic considerations, and dental implications. This structured synthesis allowed for integration of evidence quality, identification of research gaps, and discussion of clinical relevance in pediatric dental settings.

Etiology

The etiology of ADHD remains unclear; however, studies suggest that genetic, neurological, environmental, and psychological factors may contribute. Among these, neurological and hereditary influences are considered the primary determinants.[8-12,35,36]

Genetics

Approximately 80% of ADHD cases are believed to have a hereditary component.[8] Twin studies demonstrate that monozygotic twins are more likely than dizygotic twins to both exhibit ADHD, while sibling studies indicate an elevated risk of the disorder or related symptoms among siblings of affected children. Family studies further confirm the familial nature of ADHD, with first-degree relatives of affected individuals being 20–25% more likely to develop the condition.[10-11] The risk is particularly high when a parent has ADHD.[12] Current evidence suggests that no single gene exerts a strong effect; rather, ADHD is likely influenced by multiple genetic factors, including possible sex-linked traits. Candidate genes associated with ADHD include those involved in dopamine regulation and thyroid receptor function[13-15]

Neurobiological Factors

Neurological abnormalities have been implicated in the pathophysiology of ADHD. Neuroimaging studies, particularly MRI, have demonstrated structural differences in the frontal and left temporal lobe.[12] The frontal lobe is critical for attention regulation and behavioral control, whereas the temporal lobe contributes to auditory processing. Children with ADHD have also been reported to exhibit reduced cerebral blood flow and decreased glucose metabolism,[16] along with smaller volumes in certain brain regions.

Environmental

Environmental influences and gene–environment interactions are believed to increase the risk of

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ADHD. Factors such as food additives, dietary patterns, lead exposure, maternal smoking, and prenatal substance use have all been associated with the disorder.[17] Additionally, maternal nutritional factors, including low folate levels and high fat intake during pregnancy, have been linked to hyperactivity and inattentiveness in offspring.[18]

Parenting and Prenatal Factors

Children with ADHD are more likely to have a parent with a history of the disorder.[19] Socioeconomic status, parenting style, availability of psychological support, and parental psychopathology have all been identified as important predictors of symptom development.[20] Moreover, children raised in households characterized by marital discord, family dysfunction, and overt parent–child conflict are more likely to develop hyperactive traits.[21]

Psychosocial Factors

Adverse social factors,[22] as well as comorbid symptoms of depression and anxiety[23], can exacerbate ADHD manifestations. Although these factors may not directly cause ADHD, they are associated with increased symptom severity. Parent–child relationships, particularly maternal interactions, play a critical role in shaping children's genetic expression and neurodevelopment. Negative parenting behaviors, such as overly strict control or insufficient emotional support, have been linked to increased conflict and worsening of ADHD symptoms.[24] In addition, parental mental health, educational attainment, income, and overall social status significantly influence ADHD outcomes.

Prematurity/Low Birthweight Low Birthweight

Children born preterm or with low birth weight (LBW) are at increased risk of developing ADHD, particularly the inattentive subtype. Evidence indicates that infants born small for gestational age are up to three times more likely to be diagnosed with ADHD, although the underlying mechanisms remain unclear.[25]

Elements in ADHD Etiology

Magnesium (Mg)

Magnesium plays an essential role in ADHD by influencing neuronal function and fatty acid metabolism. Low magnesium levels have been associated with core ADHD symptoms such as inattention, anxiety, and aggression. Studies also report that children with ADHD often present with reduced magnesium concentrations in blood and tissues. [26]

Iron (Fe) levels (In hair and urine)

Iron is one of the first recognized essential elements in humans and has been extensively studied in hematology. Beyond its hematological role, iron is critical for normal brain function. It serves as a cofactor for tyrosine hydroxylase, the rate-limiting enzyme in dopamine synthesis. Iron deficiency impairs dopamine production and has been associated with exacerbation of ADHD symptoms. In children, iron deficiency has been shown to negatively affect cognitive, physical, social, and emotional functioning, suggesting its potential role in the etiology of ADHD.

Multiple peripheral measures are used to assess iron status, including serum iron, serum transferrin, serum ferritin, hematocrit, hemoglobin, mean corpuscular volume (MCV), red blood cell count (RBC), and total iron-binding capacity (TIBC). More recently, serum hepcidin has also been investigated as a biomarker of iron metabolism. In addition, brain iron levels and dietary intake assessments may provide insight into mineral status, while interventional studies on iron supplementation further contribute to understanding its role in ADHD.[27]

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Children with ADHD have been reported to exhibit lower iron levels in hair and urine compared with healthy controls.[28] Iron supplementation, administered at doses of 80 mg/day or 5 mg/kg/day, has demonstrated effectiveness, particularly for the inattentive subtype of ADHD, and may also enhance the therapeutic effects of psychostimulants.[29] Evidence further suggests that combined iron and zinc supplementation is more effective than iron alone.[29] However, excessive iron intake poses risks, including oxidative stress and cellular damage.[30,31]

Zinc (Zn)

Zinc is an essential trace element involved in numerous cellular processes.[32] and disruptions in zinc homeostasis are linked to various diseases. Disruptions in zinc homeostasis have been associated with various pathological conditions. Studies have shown that children with ADHD present with lower serum zinc levels compared with healthy controls[33] and also tend to have reduced daily dietary zinc intake. Zinc deficiency may contribute to ADHD symptomatology, and zinc supplementation has been recommended, particularly in populations with significant deficiency.[34]

Copper (Cu)

Copper plays an important role in catecholamine metabolism; however, no consistent direct association has been established between copper levels and ADHD symptom scores in children.[35] Instead, the copper-to-zinc (Cu/Zn) ratio appears to be more relevant, as an elevated ratio has been linked to a greater likelihood and severity of ADHD and its comorbidities. Some studies have also reported reduced copper levels in children with ADHD.[36]

Types of ADHD

Hyperactive

A child with hyperactive behavior often fidgets with their hands or feet or squirms in their seat. They may frequently leave their seat when expected to remain seated, display inappropriate behaviors such as running or climbing, and have difficulty engaging in quiet activities. Excessive talking is also a common feature.

Inattentive

A child with attention difficulties often struggles to sustain focus during tasks or recreational activities and may seem not to listen when spoken to directly. They frequently disregard instructions and fail to complete schoolwork, chores, or other responsibilities. Difficulties with organizing tasks and activities are common. Such children may avoid or dislike activities that require prolonged mental effort, such as school assignments. They also tend to misplace items necessary for daily tasks (toys, homework, pencils, books, or equipment) and are prone to distraction and forgetfulness in everyday routines.

Combined

A diagnosis of ADHD requires the presence of six or more symptoms of inattention and six or more symptoms of hyperactivity–impulsivity. Most children diagnosed with ADHD present with the combined type, which includes both inattentive and hyperactive–impulsive symptoms (Table 1).

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Table 1. Characteristics of attention-deficit/hyperactivity disorder subtypes

Attention-deficit/hyperactivity disorder types	Characteristics
Hyperactive	Talks a lot and very fast Need to move and always "on the go" Hyperactivity can be mental
Inattentive	Daydreams a lot Looks like not listening Uses many reminders to avoid forgetting
Combined	Both hyperactive and inattentive traits with varying intensity

Co-morbidities And Functional Impairments

ADHD is frequently associated with a range of psychiatric disorders and functional impairments that are often identified during clinical evaluations. Parents may express greater concern about these associated difficulties than about the core ADHD symptoms themselves. Therefore, comorbidities and functional limitations are important considerations when developing individualized treatment plans.

Neuropsychological Functioning

ADHD has been associated with deficits in executive function (EF),[9,21] d as well as with delay aversion and impaired timing. EF weaknesses, including difficulties in self-control and working memory, are linked to abnormalities in brain activity. Neuroimaging studies have demonstrated reduced activation during EF-related tasks, contributing to forgetfulness and challenges in planning.[37] Nevertheless, ADHD presents with heterogeneous neuropsychological profiles, and these deficits may vary considerably across individuals.

Emotional Functioning

Children with ADHD frequently experience difficulties in emotional regulation, including heightened frustration, irritability, and challenges in recognizing the emotions of others. These impairments can significantly affect social interactions, even in children who perform well on cognitive assessments, underscoring the importance of therapeutic interventions that specifically address emotional functioning.[38]

Social/peer Functioning

Children with ADHD frequently experience difficulties in social relationships, which may lead peers to avoid forming friendships with them.[39] Behaviors such as aggression, intrusiveness, or impulsivity can make them less desirable as playmates. Conversely, children with predominantly inattentive symptoms may appear socially withdrawn and may have difficulty recalling details of social interactions.[37]

Academic Functioning

ADHD is strongly associated with academic underachievement[40], with deficits in attention and executive function exerting a greater impact on performance than hyperactivity. Affected children are more likely to require additional educational support, repeat grades, or attain lower academic qualifications compared with their peers. Interventions should therefore include strategies aimed at strengthening academic skills to promote better long-term educational outcomes.

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Disruptive Behavior Disorders

DHD is frequently comorbid with oppositional defiant disorder (ODD) and conduct disorder (CD), affecting up to half of children with the condition.[41] Early identification and intervention are critical, as the coexistence of these disorders is associated with long-term behavioral challenges and reduced responsiveness to treatment.

Mood And Anxiety Disorders

Children with ADHD commonly experience mood-related difficulties, including depression and anxiety disorder.[42] Evidence suggests that treatment with stimulant medication may reduce the risk of developing these comorbid conditions over time. Furthermore, children who present with both ADHD and anxiety symptoms often demonstrate greater benefit from behavioral therapy approaches.

Tic Disorders

Children with ADHD frequently present with comorbid tic disorders or Tourette syndrome,[43] with 60–70% of individuals with Tourette syndrome also meeting diagnostic criteria for ADHD. Although certain medications can exacerbate tics, agents such as methylphenidate and atomoxetine have been shown to effectively manage ADHD symptoms without worsening tic severity. Addressing ADHD in children with Tourette syndrome is particularly important, given its substantial negative impact on functioning and quality of life.

Substance Misuse

ADHD has been associated with an elevated risk of substance misuse, with approximately one in four individuals with substance dependence also meeting criteria for ADHD. Although comorbid conduct disorder (CD) may further increase this vulnerability,[44] ADHD symptoms alone are significant independent predictors of later substance misuse.

Motor Coordination

Children with ADHD, particularly boys[45], often demonstrate poor motor coordination, which may result in unintentional movements accompanying deliberate actions. Such motor difficulties can lead to clumsiness, increase the risk of injuries, and contribute to challenges in overall motor tasks and sports performance.[46]

Dental Consideration Of ADHD

Early diagnosis of ADHD in children is essential for dental teams to better understand the condition and to establish a collaborative approach to care. ADHD-adapted dental practices can improve oral health outcomes, reduce stigma, and support the development of self-esteem. By incorporating ADHD-informed care principles, dental professionals can design effective preventive strategies that benefit not only children with ADHD but also the broader pediatric population.

Diagnosis and Assessment

Diagnosis of ADHD is complex and requires a comprehensive evaluation. The process should include a structured parent interview to gather information on the child's developmental history, family background, current difficulties, and fulfillment of specific diagnostic criteria. Teacher reports, while valuable, may not reliably reflect the child's overall needs. A range of standardized rating scales and checklists can assist in the diagnostic process, including the Strengths and Difficulties Questionnair[47], Achenbach's Child Behavior Checklist[48], Conners' Scales[49], Rutter's Scales[50], and the Barkley and DuPaul ADHD Rating Scale[51].

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Inattention

Six or more of the symptoms listed below must have been present for at least six months at an extent that is inconsistent with the individual's developmental level and has a detrimental influence on social and academic pursuits.For a diagnosis of ADHD, six or more symptoms must be present for at least six months to a degree that is inconsistent with the individual's developmental level and that negatively affects social or academic functioning. According to DSM-IV criteria[2], individuals aged 17 years and older must present with at least five symptoms. These symptoms may include frequently overlooking details or making careless mistakes in schoolwork, work, or other activities; difficulty sustaining attention in tasks or play activities, such as during lectures, conversations, or reading; appearing not to listen when spoken to directly, with the mind seeming elsewhere even in the absence of obvious distractions; failing to follow through on instructions and leaving schoolwork, chores, or duties incomplete; and difficulty organizing tasks and activities, including problems with sequencing steps, keeping materials in order, managing time, or meeting deadlines. Affected individuals may also avoid or be reluctant to engage in tasks requiring sustained mental effort, such as schoolwork or work-related activities, and they may frequently misplace items necessary for tasks, such as school supplies, books, tools, wallets, keys, documents, glasses, or phones. They are often easily distracted by external stimuli or unrelated thoughts and may forget to complete everyday activities, such as doing chores or running errands; in older individuals, this may include returning phone calls, paying bills, or keeping appointments.[2]

Hyperactivity and Impulsivity

An individual with hyperactivity–impulsivity frequently fidgets with or taps their hands or feet or squirms in their seat. They may often leave their seat in situations where remaining seated is expected, and they may run about or climb in inappropriate situations; in adolescents or adults, this behavior may instead present as persistent feelings of restlessness. They commonly find it difficult to engage quietly in leisure activities and often appear to be constantly "on the go" or as if driven by an internal motor. Excessive talking is also characteristic. Impulsivity may manifest as blurting out answers before a question has been fully asked, difficulty waiting for one's turn, or interrupting and intruding on others, such as by butting into conversations or activities.

For diagnosis, several symptoms must have been present before the age of 12 and must occur in two or more settings, such as home, school, or work. These symptoms must clearly interfere with or diminish the quality of social, academic, or occupational functioning. Furthermore, they must not occur exclusively during schizophrenia or another psychotic disorder and must not be better explained by another mental disorder, including mood, anxiety, dissociative, or personality disorders, or substance-related disorders.

Conditions that Co-Exist with ADHD

Anxiety Disorders

Generalized anxiety disorder is characterized by excessive and pervasive worry. Obsessive–compulsive disorder presents with recurrent intrusive thoughts or repetitive behaviors, while separation anxiety is marked by developmentally inappropriate fears of separation from a caregiver or parent.

Autism Spectrum Disorders

Autism spectrum disorders involve persistent deficits in social communication and interaction, along with restricted and repetitive patterns of behavior, interests, or activities that result in functional impairment.

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Fetal Alcohol Syndrome

Fetal alcohol syndrome, caused by prenatal alcohol exposure, is associated with learning difficulties, behavioral challenges, and distinctive physical features, including a thin upper lip and a smooth or absent philtrum.

Genetic Conditions

Hereditary predisposition plays a critical role in the development of ADHD. Approximately 50% of children with a parent diagnosed with ADHD are likely to develop the disorder, while siblings carry an estimated risk of about 33%[8]. Tannock[52] reported that genetic factors contribute between 70% and 80% to ADHD liability, as demonstrated in numerous twin and adoption studies. Research on monozygotic twins has shown a high concordance for hyperactivity, whereas dizygotic twins exhibit substantially lower similarity[8]. These findings suggest that environmental influences have comparatively limited impact on the occurrence of the disorder.

Moreover, parents and relatives of children with ADHD often present with emotional disorders, behavioral problems, or substance abuse[23]. Current genetic research aims to identify specific susceptibility genes, with particular attention to dopamine-related pathways. Of special interest are the dopamine receptor D4 (DRD4) gene and the dopamine transporter (DAT1) gene, both of which have been associated with ADHD in multiple studies[23].

Treatment Considerations

When providing dental care for a child with ADHD, it is essential to review the medical history, consider potential side effects of medications, recognize possible oral manifestations, and maintain flexibility in the treatment plan. Parents or caregivers should be encouraged to prepare the child for the dental visit in advance, while avoiding the use of anxiety-inducing words such as “shot,” “pain,” or “drill.” Dental appointments should ideally be scheduled so that ADHD medication is administered 30 to 60 minutes beforehand to optimize the child’s attention and behavior during the visit. [53]

During treatment, instructions should be kept short, simple, and delivered one step at a time to accommodate limited attention span and distractibility. Clear behavioral expectations should be established at the beginning of the appointment, and cooperation should be encouraged through positive reinforcement, including verbal praise or small rewards. Behavioral contracting, either verbal or written (for example, promising playtime after treatment), can also be used to motivate the child and improve compliance.[54]

Input from parents or caregivers regarding the child’s behavior, preferences, and dislikes should be obtained to help tailor the dental visit effectively.[54] Collaboration with the child’s primary care physician is advisable, particularly when comorbid conditions are present. A comprehensive dental history should also be taken, including information on oral habits, bruxism, tics or dyskinesia, tobacco use, self-medication, caffeine intake, diet, frequency of snacks, and beverage consumption.

Preventive strategies, such as the application of topical fluoride, should be considered to reduce the risk of dental caries. Local anesthesia must be administered with caution, and behavioral management techniques such as Tell–Show–Do should be employed to enhance cooperation.[55] Shorter, multiple appointments are generally preferable to lengthy sessions in order to maintain attention and cooperation throughout treatment.

Medical History

A comprehensive medical history is essential for all dental patients, with particular emphasis on those diagnosed with ADHD. Key areas to address

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include confirmation of the ADHD diagnosis, as well as detailed information about prescribed medications. This should cover the drug name, dosage, timing of administration, and confirmation of intake on the day of the dental visit. For optimal cooperation, ADHD medications should ideally be administered 30 to 60 minutes before the appointment to enhance attention and behavior during treatment.[53]

Potential Pharmacological Effects Relevant to Dental Care

Dental professionals should be aware of the potential oral and systemic side effects associated with medications used in the management of ADHD. Reported adverse effects include xerostomia (dry mouth), reduced olfactory sensitivity, and sinusitis (inflammation of the paranasal sinuses). Additional oral complications may involve dysgeusia (altered taste), sialadenitis (inflammation of the salivary glands), stomatitis (inflammation of the oral mucosa), gingivitis, and glossitis (inflammation of the tongue). Other possible manifestations include tongue discoloration, bruxism (teeth grinding or clenching), and dysphagia (difficulty swallowing).[8,9]

Healthcare Providers Treating the Patient

Consultation with other healthcare providers, such as the patient's primary care physician, is essential when questions arise about treatment, behavior management, or medication used, especially in patients with coexisting conditions like depression, anxiety, or intellectual disabilities. Research indicates a correlation between ADHD and increased dental anxiety, with individuals with ADHD more likely to experience significant anxiety during dental care.[9]

Dental History

The dental examination should include a dental history.

Oral Habits

Children with ADHD frequently demonstrate oral behaviors such as nail biting, lip biting, and chewing on things (for example, pens or pencils).

Bruxism

Both daytime and nighttime bruxism occur more frequently in medicated children with ADHD, particularly those receiving central nervous system stimulants such as methylphenidate or amphetamines, compared with non-medicated or non-ADHD peers.

Dyskinesia (tics)

Certain ADHD medications may induce muscle hyperactivity and involuntary movements. Careful adjustment of medication type and dosage by the prescribing physician is essential to minimize disruptive behaviors and reduce dyskinesia.

Homecare Routine

Children with ADHD often experience difficulties in maintaining adequate oral hygiene, with only 48% reported to brush their teeth nightly compared with 82% of their peers.[6] Contributing factors include deficits in attention, difficulties with task initiation, and parent–child conflicts during daily routines.

Dietary Patterns

Dental practitioners should inquire about a patient's dietary habits, including meal frequency and the consumption of snacks or beverages between meals. Evidence indicates that individuals with ADHD often eat more than five times per day, resulting in increased exposure to high-

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carbohydrate foods and a heightened risk of developing dental caries.[8]

Oral examination

Minor orofacial abnormalities have been reported in individuals with ADHD. While these features typically do not result in major esthetic concerns, they remain clinically relevant. Reported findings include a larger head circumference, epicanthic folds (skin folds covering the tear ducts), hypertelorism (increased distance between the eyes), and low-set ears. Additional craniofacial characteristics may involve an elongated lower face, a pointed chin, a short upper lip, a wider oral aperture, and a steep palatal vault. Intraoral features can include a fissured tongue, geographic tongue, gingival overgrowth, aberrant frenula (presence of additional frenula), and irregular, crowded, or malformed teeth.

Traumatic Injuries

Children with ADHD are more prone to traumatic injuries[12], particularly involving the mouth and face, due to their tendency toward risk-taking behaviors such as running, climbing, biking, and skateboarding. Impulsivity, distractibility, and hyperactivity may further complicate cooperation during dental appointments, increasing stress for both the child and the dental team. Nevertheless, not all children with ADHD experience traumatic dental injuries (TDIs), and not all children with TDIs have ADHD.

Dental Caries

ADHD has been associated with up to a twelvefold increase in the risk of dental caries compared with non-ADHD counterparts.[12] Core symptoms of ADHD can interfere with oral hygiene practices and reduce motivation for preventive care. In some cases, parents may inadvertently contribute to risk by offering cariogenic treats as rewards. Furthermore, medication side effects, particularly xerostomia (dry mouth), diminish the protective role of saliva and increase susceptibility to tooth decay. To relieve the discomfort of xerostomia, patients may consume soft drinks more frequently, which further elevates the risk of caries development.[8]

Oral Health Instruction

Tooth Brushing

The Tell–Show–Do technique is particularly effective for teaching toothbrushing to children with ADHD. Instructions should be given one step at a time, with key points repeated and supported by engaging visual or interactive materials.[17] The use of timers or electric toothbrushes with quadrant pacers can help ensure thorough brushing. Directions should remain clear, simple, and concise.

Parental Guidance

Providing parents with a concise summary of key information from the dental visit is essential. Parents should be encouraged to use non-food-based rewards, such as stickers, small incentives, or privileges, to reinforce home care routines. It is also important to recognize that children with ADHD often function at an executive level approximately 30% below their chronological age. For instance, a 12-year-old with ADHD may demonstrate executive skills comparable to those of an 8-year-old, necessitating additional parental support for daily tasks such as oral hygiene.

Additional Recommendations for the Dental Team

Scheduling Appointments

Dental appointments for children with ADHD should ideally be scheduled in the early morning, approximately 30 to 60 minutes after administration of stimulant medication, when patients are more attentive and less fatigued.

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Scheduling should avoid "rebound periods" or medication "holidays." For extensive treatment needs, care should be divided into shorter sessions, with breaks provided as necessary. Increased recall visits may be indicated for patients with dental caries, gingival inflammation, or xerostomia, and topical fluoride applications should be recommended to help slow caries progression. Appointment reminders and advance confirmations are also important to minimize missed visits.

Communication with the ADHD Patient

Dental professionals should maintain direct eye contact when explaining procedures, as this can help sustain the child's attention and enhance understanding. Unexpected or unannounced interventions may be unsettling for children with ADHD and can contribute to heightened agitation.

Reinforcement During the Appointment

In the dental setting, reinforcement can be provided through various strategies, including frequent verbal praise, the use of verbal or written behavioral contracts (for example, "When you... then you will..."), and tangible rewards such as stickers, temporary tattoos, trading cards, or tokens to encourage cooperation.

Local Anesthesia

Local anesthetics should be administered with caution in patients with ADHD. Achieving profound anesthesia is essential to prevent the release of endogenous epinephrine, which may interact with stimulant medications such as methylphenidate. An aspirating syringe should always be used to minimize the risk of intravascular injection, thereby reducing the likelihood of compounded vasoconstrictor effects that could elevate blood pressure and heart rate.

Overall ADHD Treatment Goals

The treatment of ADHD is aimed at reducing symptoms, improving daily functioning, and addressing behavioral challenges. Primary care providers play an important role in supporting families by offering ADHD management strategies and parenting guidance. Children with ADHD are eligible for educational support under Section 504 of the Rehabilitation Act or the Individuals with Disabilities Education Act (IDEA), and parents may request an evaluation for accommodations or an individualized education program (IEP).

For children younger than six years, behavioral therapy is recommended as the first-line intervention.[31,32] Pharmacological treatment may be considered for moderate to severe symptoms that do not respond adequately to behavioral approache.[31,33] For children aged six years and older, medication is typically the primary treatment option, while behavioral interventions may be used as adjuncts when medication proves ineffective or produces adverse effects.

Behavior Therapy

Behavior therapy focuses on modifying the physical and social environment to promote positive behavioral change. A central component is parent training, which equips caregivers with strategies to guide behavior and enhance self-regulation in children. Common techniques include the use of positive reinforcement to encourage desirable behaviors, planned ignoring to reduce undesirable behaviors, and the application of appropriate consequences when goals are not met. Consistent use of rewards and consequences, combined with gradually increasing expectations, helps support long-term behavioral progress. Although behavior therapy programs may differ in their methods, they are unified by shared core principles that aim to achieve similar outcomes[52] (Table 2).

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Table 2. Evidence-based behavioral interventions for children with attention-deficit/hyperactivity disorder

Intervention type	*Description*	*Typical Outcome*
Behavioral Parental Training (BPT)	Parents are taught behavior-modification principles to apply at home.	Increased child compliance with parental instructions; improved parental understanding of behavioral strategies; high parental satisfaction with the intervention.
Behavioral classroom management	Teachers are trained to apply behavior-modification strategies within classroom settings.	Enhanced attention to teacher instructions; better adherence to classroom rules; reduction in disruptive behaviors; improved academic productivity.
Behavioral peer interventions (BPI)	Focuses on improving peer relationships, often through weekly group-based sessions. These may include clinic-based social skills training alone or combined with behavioral parent training and/or medication.	Clinic-based interventions have shown minimal effects; the social relevance of these interventions is questionable. Some studies combining BPI with BPT demonstrated improvements in parent-rated ADHD symptoms, though no significant changes in social functioning or parent-rated social behavior were observed.

School Programming and Supports

Behavior therapy that links home and school settings has been shown to improve outcomes for children with ADHD. School-based interventions, such as preferential classroom seating and modified assignments, may be incorporated into a 504 Plan or an individualized education program (IEP). Clinicians should be familiar with local regulations governing educational accommodations to guide families effectively. The impact of coexisting conditions varies, with some manageable in primary care and others requiring referral for specialist care.[53]

Pharmacologic Treatment

Psychostimulants, such as methylphenidate (Ritalin) and dextroamphetamine, are the most commonly prescribed and effective medications for ADHD, and they are recommended as first-line treatments.[52,53] Non-stimulant alternatives include atomoxetine and alpha-2 adrenergic receptor agonists, such as guanfacine and clonidine, although these agents are generally considered less effective. Some families may choose second-line or non-stimulant options to address comorbid conditions or to avoid stimulant-related side effects.

The administration of methylphenidate prior to dental visits may improve cooperation and

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behavior during treatment. In cases where first-line therapies are ineffective or poorly tolerated, off-label medications, including certain antidepressants or antipsychotics, may be considered as adjunctive or alternative approaches.

Psychostimulants

ADHD medications, particularly stimulants that act on dopaminergic pathways, not only alleviate core symptoms but may also enhance academic performance, with treated children less likely to repeat a grade. Evidence further indicates that stimulant use does not increase the risk of substance abuse, and may even improve driving performance in adolescents and young adults with ADHD.[54] Both amphetamines and methylphenidate have demonstrated efficacy, although individual responses vary. When one stimulant proves ineffective, the other should be trialed, as 80–90% of children show a positive response following adequate trials with both agents.[55]

Effects of Stimulant Medications

Children treated with stimulant medications for ADHD generally demonstrate significant improvements across behavioral, emotional, and academic domains. They tend to display calmer and less hyperactive behavior, longer attention spans, and reduced oppositionality, which facilitates easier management at home and school. Responsiveness to discipline often improves, accompanied by greater awareness of the needs of others. Emotional stability is enhanced, with fewer temper tantrums, improved frustration tolerance, and reduced impulsivity. Children also exhibit better planning, patience, and more organized behavior. Academic outcomes frequently improve, as reflected in higher grades and more legible handwriting.

The improvement in functioning among children with ADHD can be dramatic. Unlike other treatments, such as antidepressants or mood stabilizers, which restore patients to their baseline level of functioning, stimulants often enable children to perform better than they ever have before.

Drug Interactions and Dental Treatment

When planning dental treatment with non-intravenous sedation, clinicians should consider all concurrent medications to avoid potential drug interactions, such as the combination of stimulants with sedatives. Commonly used sedation agents include diazepam and midazolam, although factors such as cost, availability, and provider training may influence their selection. The treatment setting and type of procedure can also affect both sedation choice and success. Patient-specific factors, including weight, must be taken into account to prevent overdosing.

Methylphenidate and Bone Health

Children treated with methylphenidate may experience reduced bone mineral density (BMD), which can be assessed using mandibular cortical width (MCW) as a surrogate marker.[37] Methylphenidate, which influences dopamine and norepinephrine levels, may cause side effects such as decreased appetite, weight loss, and sleep disturbances, all of which can negatively impact bone health. Research indicates that children receiving methylphenidate have significantly lower MCW compared to controls, reflecting reduced BMD. Regular dental evaluations and radiographs are therefore important for monitoring these potential effects.

Specific Oral Health Risks for ADHD Patients

Patients with ADHD, particularly those receiving stimulant medications, may encounter multiple oral health challenges. These include an increased risk of dental trauma due to impulsivity and

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bruxism, as well as a reduced attention span that complicates plaque control and oral hygiene practices. Decreased salivary flow, often associated with stimulant use, further elevates the risk of dental caries. Rebound appetite following medication wear-off may also lead to high-carbohydrate snacking near bedtime, contributing to decay. In addition, possible interactions between stimulant medications and local anesthetics necessitate caution during dental procedures.

DISCUSSION

ADHD is a heterogeneous disorder in which etiological factors, clinical presentations, and treatment responses vary considerably among individuals. This complexity presents challenges for clinicians when addressing parental concerns or providing tailored guidance for children with ADHD. Despite substantial advances in research, knowledge regarding its risk factors and the most effective treatment strategies remains incomplete.[55]

In the context of pediatric dentistry, evidence indicates a significant association between ADHD and an increased risk of oral health problems, including dental caries, bruxism, and traumatic dental injuries.[52] These risks are often exacerbated by behavioral difficulties, inadequate oral hygiene practices, and adverse effects of stimulant medications such as xerostomia and appetite suppression.[52–55] Within the dental setting, behavior management is pivotal to achieving successful treatment outcomes. Strategies such as scheduling short appointments, providing clear one-step instructions, and employing positive reinforcement have been shown to improve cooperation in children with ADHD.[54] Furthermore, effective collaboration with caregivers and coordination with medical professionals are essential for adapting treatment plans to the child's behavioral profile and medication schedule. [51]

Despite these insights, significant gaps remain in the literature. Few studies have evaluated dental interventions specifically designed for children with ADHD, and much of the existing evidence is extrapolated from general pediatric or behavioral dentistry research. In addition, variations in diagnostic criteria, study design, and outcome measures limit the comparability of findings across studies. This lack of standardization highlights the need for future research focused on developing and validating dental management protocols tailored to this population.

CONCLUSIONS

Pediatric dental professionals play a vital role in the multidisciplinary care of children with ADHD. By understanding the neurobehavioral and pharmacological aspects of the disorder, they can contribute to improved oral health outcomes and enhanced quality of life for affected children. Future research should prioritize the development and validation of ADHD-specific dental behavior management protocols, the investigation of long-term oral and craniofacial effects of stimulant medications, the evaluation of caregiver education on oral hygiene practices, and the exploration of digital tools and gamified strategies to improve cooperation during dental care.

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