

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) refers to a neuropsychological developmental disorder that affects periods of attention, impulse control and activity levels in children. It is the most common neuropsychiatric disorder in children, affecting the population from all socioeconomic and cultural levels. It is a chronic disorder with up to half of those individuals diagnosed in childhood continuing to have symptoms into adulthood.

This syndrome has been widely studied in many fields of medicine, including neurology, psychiatry, psychology, and psycho pedagogy, but, it has not been studied in depth in dentistry.

Some anomalies in the oral cavity of children suffering from ADHD might be noted like fissured or geographic tongue, aberrant frenulae and irregular, crowded, or malformed teeth.

Children with ADHD might have a higher prevalence of dyskinesia and bruxism (probably due to stress and sleep disorders), and dental trauma (due to violence or falls and collisions), as well as poor oral hygiene, which can result in a higher incidence of oral diseases and caries.

There is a subset of children diagnosed with the Inattentive type of ADHD who have attention problems but do not experience any overactivity and impulsivity symptoms. These children are not likely to be especially challenging in the dental setting. However, many children with ADHD are overactive and/or impulsive and are likely to present significant challenges to the pediatric dentist.

The behavioral characteristics of children with ADHD can determine how well a dental appointment goes. The pediatric dentist must be aware of the condition of children with ADHD and recognize the problem in order to establish a proper treatment plan and a stable environment for these children.

The aim of the present study is to achieve an insight on the oral findings in children with ADHD and their behavior in the dental clinic.

Review of Literature

Attention-deficit hyperactivity disorder (ADHD) is a neurobehavioral disorder characterized by pervasive inattention and/or hyperactivity-impulsivity, which can result in significant functional impairment. This condition has been described as the most common behavioral disorder of childhood and the most widely studied, but it still elicits controversies and differences of opinion. Depending upon the sampling strategies, methodological differences, and diagnostic criteria of the studies, the estimated prevalence of ADHD ranges from 3% to 18% (*Bloom and Dey, 2007*).

Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) **Criteria for ADHD**

The Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) in the year 2000 provides criteria for diagnosing ADHD.

DSM-IV Criteria for ADHD:

Criteria I: Either A or B:

Subdivision A includes symptoms of inattention, while subdivision B includes symptoms of hyperactivity and impulsivity. Six or more of the following symptoms of inattention or hyperactivity/impulsivity should have been present for at least 6 months to a point that is disruptive to the parents and inappropriate for developmental level of the child:

Subdivision A: Inattention

- Often does not give close attention to details or makes careless mistakes in school work or other activities.

- Often has trouble keeping attention on tasks or playing activities.
- Often does not seem to listen when spoken to directly.
- Often does not follow instructions and fails to finish school work, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions).
- Often has trouble in organizing activities.
- Often avoids, dislikes, or doesn't want to do things that take a lot of mental effort for a long period of time (such as schoolwork or homework).
- Often loses things needed for tasks and activities (e.g. toys, school assignments, pencils, books, or tools).
- Is often easily distracted.
- Is often forgetful in daily activities, (*American Psychiatric Association, 2000*).

Subdivision B: Hyperactivity/impulsivity:

Hyperactivity

- Often fidgets with hands or feet or squirms in seat.
- Often gets up from seat when remaining in seat is expected.
- Often runs about or climbs when and where it is not appropriate (adolescents or adults may feel very restless).
- Often has trouble playing or enjoying leisure activities quietly.
- Is often "on the go" or often acts as if "driven by a motor".
- Often talks excessively, (*American Psychiatric Association, 2000*).

Impulsivity

- Often blurts out answers before questions have been finished.
- Often has trouble waiting one's turn.
- Often interrupts or intrudes on others (e.g., butts into conversations or games), (*American Psychiatric Association, ٢٠٠٠*).
- Criteria II: Some symptoms that cause impairment were present before the age of ٧ years old (*American Psychiatric Association, ٢٠٠٠*).
- Criteria III: Some impairment from the symptoms is present in two or more places or settings (e.g. at school/work and at home) (*American Psychiatric Association, ٢٠٠٠*).
- Criteria IV: There must be clear evidence of significant impairment in social, school, or work functioning (*American Psychiatric Association, ٢٠٠٠*).
- Criteria V: The symptoms do not happen only during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder. The symptoms are not better accounted for by another mental disorder (e.g. Mood Disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder) (*American Psychiatric Association, ٢٠٠٠*).

Types of ADHD:

Based on these criteria, three types of ADHD are identified:

1. ADHD, *Combined Type*: if both criteria 1A and 1B are met for the past 6 months.
2. ADHD, *Predominantly Inattentive Type*: if criterion 1A is met but criterion 1B is not met for the past six months
- ADHD, *Predominantly Hyperactive-Impulsive Type*: if Criterion 1B is met but Criterion 1A is not met for the past six months. (*American Psychiatric Association, 2000*).

Signs and symptoms of ADHD:

In children with ADHD, cognitive and executive functions may be impaired, leading to significant behavioral problems that affect everyday life (*Biederman et al., 2000*).

Furthermore, children with ADHD function at an age level with 30% reduction in mental capabilities. This means that a 12-year-old child with ADHD performs such executive functions at a level comparable to that of an 8-year-old child. Thus, children with ADHD need more support from parents in many daily activities, including coping with their oral health (*Blomqvist, 2000*).

In the field of child psychiatry, psychiatrists tried to explain different signs and symptoms of ADHD criteria (inattention, hyperactivity, and impulsivity).

Signs and symptoms of ADHD in inattention:

The executive functions are the mental control processes that enable self-control, motivation, flexibility, and working memory, and are

necessary to maintain an appropriate problem-solving set for the attainment of a future goal (*Pennington and Ozonoff, 1997*). The executive functions also enable an individual to adjust to a social situation; therefore, they become more important with increasing age (*Denckla, 1997*).

These executive functions include the ability to sustain focus and filter out irrelevant and distracting stimuli; and plan, organize and monitor thoughts and working memory. This working memory is the ability to temporarily hold information in mind, manipulate it and use it to guide behavior (*Schweitzer et al., 2004, and Roth and Saykin, 2004*).

Inattention frequently presents as a short attention span that prevents the person from focusing continuously on verbal and written instructions, resulting in difficulties in learning new tasks and the commission of careless mistakes (*Seidman et al., 2004*). It may appear that the person is simply daydreaming. People with ADHD often avoid advanced educational and employment opportunities because of their inability to sustain mental effort as well as difficulty in organizing tasks and finishing projects (*Friedlander et al., 2007*).

In social situations, they are distracted easily during conversations and activities and often are forgetful (for example, adults missing appointments and misplacing and losing items that are necessary for the activities of daily living), (*Friedlander et al., 2007*).

Signs and symptoms of ADHD in hyperactivity:

Hyperactivity may reflect an internal sense of anxiety and nervousness, which hinders people's ability to unwind and relax and

exacerbates their inattention (for example, being unable to sit at a desk for long periods or sit through a movie). Hyperactivity is evident as people with ADHD fidget (for example, persistent pencil tapping, foot tapping or both) and lead chaotic lifestyles, for example, adults attempting to work two jobs with long hours (*Adler and Cohen, ۲۰۰۴*).

Signs and symptoms of ADHD in impulsivity:

Impulsivity makes it difficult for people with ADHD to wait for their turn and can lead to interrupting others when they are busy and finishing the sentences of others with whom they are speaking. In adults, impulsive actions that commonly occur include excessive spending of money, frequent job changes, and traffic violations (*Barkley, ۲۰۰۴*).

Etiology

Concerning the etiology, many possible causes have been studied:

I- The possibility of genetic factors being involved

II- Neurological factors in ADHD

III- Neurotransmitter deficiencies in ADHD

IV- Other factors affecting the etiology of ADHD

I- The possibility of genetic factors being involved:

A- Family aggregation studies

Research shows that between ۱۰% and ۳۵% of the immediate family members of children with ADHD are likely to have the disorder (*Biederman et al., ۱۹۹۲; Levy and Hay, ۲۰۰۱*). Even more striking is the finding that if a parent has ADHD, the risk of the

offspring acquiring ADHD is 57%. (*Biederman et al., 1990 and Faraone, 2004*).

B- Twin studies

Studies found that if one twin was diagnosed as having ADHD, the concordance for the disorder is 77% to 81% in monozygotic (identical) twins and 4% to 29% in dizygotic (non-identical) twins (*Gilger et al., 1997 and Sherman et al., 1997*). In a later study, the monozygotic (identical) twin of a child with ADHD has a greater than 90 % chance of having the disorder (*Biederman et al., 1990 and Faraone, 2004*).

C- Molecular genetics research

Studies have indicated that ADHD might be caused by interacting genes, such as the gene for the β -receptor of the thyroid hormone (GRTH), the dopamine transporter gene (DAT) and the dopamine D₄ receptor gene (DRD₄) (*Pérez, 2007*).

Evidence for the involvement of the dopamine D₄ receptor gene is compelling, because a variant form of this gene leads to a blunted response to the neurotransmitters dopamine and norepinephrine, and an imbalance of these neurotransmitters in the frontal lobes of the brain is believed to be responsible for such symptoms as inattention, lack of alertness, and impaired organization and planning, (*Lanau et al, 1997, and Larisch et al, 2007*). The administration of stimulants and certain tricyclic antidepressants (TCAs) appears to increase the activities of these neurotransmitters in the brain, thereby ameliorating these symptoms (*Wilens et al, 2007 and Biederman, 2000*).

II- Neurological factors in ADHD

Injuries to the central nervous system e.g. infection, toxic agents and prolonged hypoxia have been associated with ADHD (*Mailman and Lewis, 1997*).

There is some evidence of reduced neuro-metabolite activity in the right frontal region of the brain, with the degree of this activity being associated with degree of attention problems on a continuous-performance test (*Yeo et al., 2007*).

III- Neurotransmitter deficiencies in ADHD

Possible neurotransmitter dysfunction or imbalances have been proposed, resting chiefly on the responses of subjects with ADHD to dopamine and norepinephrine reuptake inhibitors and agonists (*Pliszka et al., 1997 and Spencer et al., 2007*).

IV- Other factors affecting the etiology of ADHD

• Pregnancy and Birth Complications

It was found that the younger the mother's age is at delivery, the lower the educational level, the longer the time between onset of labor and birth, and the presence of delivery complications accounted for 32% of the variance in ADHD (*Claycomb et al., 2004*).

Other researchers demonstrated a relationship between low birth weight and the development of ADHD. They studied possible environmental contributions to ADHD by identifying monozygotic twins in which only one twin was affected by ADHD. It was found that the affected twin was smaller at birth and more likely to have experienced a breech delivery (*Sharp et al., 2007 and Knopik et al., 2009*).

• Environmental toxins

An environmental agent that may be associated with a higher risk of ADHD is high levels of lead in the bodies of young preschool children. Elevated body lead burden has been shown to have a small but consistent relationship to the symptoms of ADHD (*Needleman et al., 1990*).

Since lead is no longer allowed in paint and is usually found only in older buildings, exposure to toxic levels is not as prevalent as it once was. However, those children who live in old buildings in which lead still exists in the plumbing or in lead paint that has been painted over may be at risk (*Needleman et al., 1990*).

• Smoking and alcohol abuse

The relationship between maternal smoking during pregnancy and ADHD remains significant even after symptoms of ADHD in the mother are controlled (*Mick et al., 2007*).

Recently, elevated levels of phenylalanine in mothers with phenylketonuria have been associated with higher levels of hyperactive-impulsive symptoms in their offspring (*Antshel and Waisbren, 2007*).

An association was identified between maternal alcohol consumption during pregnancy and the development of ADHD. Fetal alcohol syndrome (FAS) and fetal alcohol effects (FAE) increase the likelihood of ADHD symptoms (*Knopik et al., 2009*).

• Psychosocial and environmental factors

Some authors state that children with ADHD usually come from dysfunctional families and have a parent with the same psychopathology (*Biederman et al., 1994*).

In theory, some factors with environmental components that can have an effect on ADHD are attachment disorders, levels of familial conflict, caregiver warmth and support, caregiver educational achievement, caregiver substance use, and child abuse trauma (*St. Sauver et al., 2004*).

• Food Additives and Sugar

It has been suggested that attention disorders are caused by refined sugar or food additives, or that the symptoms of ADHD are exacerbated by sugar or food additives. In 1982, the National Institutes of Health held a scientific consensus conference to discuss this issue. It was found that diet restrictions helped about 6% of children with ADHD, mostly young children who had food allergies (*Consensus Development Panel, 1982*).

Associated comorbidity

The term “comorbid” is used to indicate a medical condition existing simultaneously but independently with another condition in a patient.

One study using a large community sample showed that up to 44% of subjects with ADHD had at least one other psychiatric disorder, 32% had two others, and 11% had at least three other disorders (*Szatmari et al., 1989*).

Some of the associated comorbid conditions that have been reported include oppositional/defiant disorder, conduct disorder (**Nigg et al., 1991**), anxiety disorder, Tourette's syndrome, obsessive-compulsive disorder, and learning disabilities (**Pliszka, 1991**).

Furthermore, studies report that ADHD affects nearly 40% of the children with dyslexia (**Friedlander et al., 1994**) and that up to 10-20% of children with ADHD have associated specific learning disability (SpLD) which is manifested by significant unexpected, specific and persistent difficulties in the acquisition and use of efficient reading (dyslexia), writing (dysgraphia) or mathematical (dyscalculia) abilities despite conventional instruction, intact senses, normal intelligence, proper motivation, and adequate socio-cultural opportunity (**Busch et al., 2007**).

Prevalence

Estimates vary and may go as high as 17.7%. The population rates may vary according to the population that is sampled, the diagnostic criteria, and diagnostic instruments that are used (**Cantwell, 1997**).

The prevalence of ADHD has been reported to be 3% to 6% in 1997 (**American Academy of Child and Adolescent Psychiatry, 1997**), and 4 to 9 % in a later study (**Adler, 2004 and Barkley et al., 2007**).

In the Middle East, the prevalence was recorded in Qatar to be 14.1% for ADHD symptoms among boys and 4.4% among girls respectively (**Bener et al., 2007**).

In a recent study in Cairo, Egypt, the prevalence of ADHD in a preparatory school was 9.4%. (*El Missiry et al., 2009*).

General Management

Treatment involves a multimodal intervention. However, clear and definite results have not proven the efficacy of these therapies when used either alone or in combination (*Elia et al., 1999*). Other authors mentioned the importance of the child's diet, even though more studies are needed to confirm the scientific principles proposed (*Ramanathan and White, 2001*). The multimodal intervention involves combining pharmacological and psychological treatments with a supportive management strategy, in order to control the symptoms of ADHD and improve social and academic functioning (*Rutter and Taylor, 2007*).

1. Psychotherapy: Psychotherapy works to help people with ADHD to like and accept themselves despite their disorder. It does not address the symptoms or underlying causes of the disorder.

In psychotherapy, patients talk with the therapist about upsetting thoughts and feelings, explore self-defeating patterns of behavior, and learn alternative ways to handle their emotions. As they talk, the therapist tries to help them understand how they can change or better cope with their disorder (*National Institute of Mental Health, 1997*).

2. Behavioral therapy (BT): This helps people develop more effective ways to work on immediate issues. Rather than helping the child understand his or her feelings and actions, it helps directly in changing their thinking and coping and thus may lead to changes in

behavior. The support might be practical assistance, like help in organizing tasks or schoolwork or dealing with emotionally charged events. Or the support might be in self-monitoring one's own behavior and giving self-praise or rewards for acting in a desired way such as controlling anger or thinking before acting (*National Institute of Mental Health, 1997*).

3. Social skills training: This can also help children learn new behaviors. In social skills training, the therapist discusses and models appropriate behaviors important in developing and maintaining social relationships, like waiting for a turn, sharing toys, asking for help, or responding to teasing, then gives children a chance to practice. For example, a child might learn to “read” other people's facial expression and tone of voice in order to respond appropriately. Social skills training help the child to develop better ways to play and work with other children (*National Institute of Mental Health, 1997*).

4. Support groups: These help parents connect with other people who have similar problems and concerns with their ADHD children. Members of support groups often meet on a regular basis (for example monthly) to hear lectures from experts on ADHD, share frustrations and successes, obtain referrals to qualified specialists and information about what works. There is strength in numbers, and sharing experiences with others who have similar problems helps people know that they are not alone (*National Institute of Mental Health, 1997*).

5. Parenting skills training: This training is offered by therapists or in special classes, gives parents tools and techniques for managing their child's behavior.
