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Attention Deficit Hyperactivity Disorder: A review and guide for dental professionals

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Abstract

Children with Attention Deficit Hyperactivity Disorder (ADHD) are presenting to the dental surgery in increasing numbers. The diagnosis of ADHD is often associated with confusion and misunderstanding. This paper summarises current knowledge on the aetiology, epidemiology, diagnosis and management of this common behavioural condition. It then goes on to make suggestions that may assist the dental practitioner in successfully treating such clients.

Key words: ADHD, attention deficit, behaviour, paediatric dentistry

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a common developmental disorder affecting about 3–5 per cent of the population (depending on the precise definition used). Boys are affected much more commonly than girls. It is characterised by developmentally inappropriate degrees of impulsivity, inattention and often hyperactivity. The symptoms are noted from early childhood, usually well before school entry and are present in all settings e.g. home and school.

The term ADHD is currently used to describe a range of children with varying functional difficulties, but who share the feature of poorly sustained attention. Some are extremely impulsive, some aggressive, others quiet and restless. Many have low self-esteem. Commonly associated problems (comorbidities) include developmental language disorders, anxiety, oppositional-defiant behaviours, fine motor and coordination difficulties and specific learning disabilities. Virtually all children with ADHD have deficits in short-term auditory memory, meaning they find it very difficult to retain more than one or two brief instructions in their minds.

ADHD can be highly disruptive to families, and can result in academic underachievement and social isolation. It presents significant challenges not only for the child but also those living and working around that child – the parents, teachers and indeed the dental practitioner. This article reviews the current knowledge and theoretical understanding of ADHD and makes some suggestions for strategies to increase the success of a dental visit.

Aetiology

ADHD has been re-conceptualised repeatedly over several decades of research. The pendulum of theories of causation has swung from the biological to the environmental and back again. This is reflected in the different diagnostic labels that have been used to describe these children over the years: 1920s–1950s – post-encephalitic behaviour disorder, minimal brain damage, minimal cerebral dysfunction; 1960s–1970s – hyperkinetic reaction of childhood (psychodynamic theory popular, parent-blaming); 1980s–1990s – attention deficit disorder (with or without hyperactivity).

In recent times there has been a focus on neurochemical, electroencephalic, dynamic metabolic imaging and genetic differences between children with ADHD and controls. Children with ADHD appear to have higher levels of noradrenaline activity and lower dopamine activity than controls (Pliszka *et al*., 1996). On standard electroencephalograms (EEG), children with ADHD have been found to have increased theta (4–8Hz, particularly frontally) and decreased beta 1 discharges (12–20Hz, particularly temporally) compared to controls, which is accentuated under task conditions e.g. reading, drawing (Mann *et al*., 1992). More recently, sophisticated techniques for analysis of EEG data have been applied to children with ADHD. These procedures include quantitative frequency analysis of the EEG relative to normative data (neurometrics), analysis of event-related potentials (during a task), and automated topographic displays of brain electrical activity (brain mapping) (Tannock, 1998). However in the absence of well-established norms or the ability to discriminate between groups with different diagnoses (e.g. ADHD and learning disability), the clinical utility of these techniques is limited (Levy and Ward, 1995). Functional neuro-imaging studies have been used to attempt to define differences between children with ADHD and controls in cerebral metabolic activity on and off task.

Single-photon emission computed tomograph (SPECT) studies, which examine cerebral blood flow, have demonstrated relative hypoperfusion of the frontal and striatal regions in subjects with ADHD compared to controls (Lou *et al*., 1984; Lou *et al*., 1989). Results of positron emission topography (PET) studies of regional cerebral glucose metabolism have yielded contradictory findings (Matochik *et al*., 1994).

Strong evidence for a genetic contribution has emerged from Australian twin studies, demonstrating much higher concordance rated among pairs of monozygotic twins than same-sex dizygotic twins (Levy *et al*., 1996). Although a specific inheritance pattern for ADHD is yet to be determined, a number of researchers are investigating candidate genes. In summary, ADHD appears to be a biologically determined condition, the manifestations of which are modified by environmental circumstances. While there is no current, and unlikely to be future, diagnostic laboratory tests for ADHD, this research has been important in identifying some of the biological correlates of ADHD behaviours, and may prove helpful in refining more targeted therapies.

Current theory regarding the neuro-psychological basis of the observed behaviours in children with ADHD centres on the concept of response inhibition (Barkley, 1997; Denckla, 1996). These children have deficits in self-regulation. They seem to be less able to inhibit cognitive +/- motor impulses than most children. They have a reduced capacity for 'working memory'. This can be thought of like the RAM of a computer. That is, they are not good at retaining information for use in the next stage of a task. In addition, their internalisation of language is less well developed than that of their same-age peers. These factors mean that children with ADHD find it very hard to plan and persist with tasks and activities directed towards a goal that is less than immediate.

The above difficulties with so-called 'executive function' translate into the core functional difficulties manifested by children with ADHD. These include poor effort persistence, inability to tolerate delayed gratification and unpredictable outward expressions of impulses (e.g. talking, moving). There is often excessive motor activity. Behaviour modification strategies that usually work successfully for most children (such as praise, rewards to positively reinforce acceptable behaviour) generally work less effectively with ADHD children, though they may still be appropriate.

Epidemiology

Estimates of the prevalence of ADHD vary from less than 1 per cent to greater than 20 per cent, depending on the definition used. Rates of diagnosis and treatment of ADHD are consistently higher in North America than in Europe (Anderson, 1996). While the label ADHD is used in the USA, in the UK many such children would receive the diagnosis of Conduct Disorder. However when the same standardised instruments have been administered in these two countries, the prevalence and severity of the hyperkinetic/impulsive/inattentive behavioural disorder, however labelled, are similar (Prendergast, 1988). Thus differences in reported prevalence appear to be the result of variation in recognition and diagnostic practices, rather than true differences.

A consensus of opinion is emerging that 3–5 per cent of children have ADHD. This estimate is based on statistical deviance (two standard deviations above the mean on standardised measures), and bears a reasonable relationship to the proportion of children who have clinically significant difficulties with inattentive, impulsive, restless behaviour (Barkley, 1990). ADHD is consistently diagnosed more frequently in boys than girls. In community samples the ratio is usually around 3–4:1 (Szatmari *et al*., 1989; Trites, 1979). In clinic samples however the ratio is generally in the order of 9–10:1 (Barkley, 1990). This reflects the fact that boys, who tend to display more aggressive and antisocial behaviour, are more likely to be identified as having problems and to be referred for assessment and treatment. There is little variation across social classes (Szatmari *et al*., 1989).

Diagnostic assessment

The assessment of a child for the diagnosis of ADHD requires a number of essential components (*Table 1*). These include a detailed developmental history, physical,

Table 1. Assessment for ADHD

- History
  – developmental
  – academic
  – behavioural
- Examination
  – including neurological, neuro-developmental, vision
- Standardised behaviour rating scales (parent & teacher) eg Conners
- Psychometric testing
  – cognitive
  – academic achievement
- Liaison with teachers

Table 2. Summary of the DSM-IV (1994) diagnostic criteria for ADHD

Inattention

1. Often fails to give close attention to details in school work, work or other activities
2. Often has difficulty sustaining attention in tasks or play activities
3. Often does not seem to listen when spoken to directly
4. Often does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace
5. Often has difficulty organising tasks or activities
6. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort
7. Often loses things necessary for tasks or activities
8. Is often easily distracted by extraneous stimuli
9. Is often forgetful in daily activities

Hyperactivity/Impulsivity

1. Often fidgets with hands or feet and squirms in seat
2. Often leaves seat in classroom or in other situations in which remaining seated is expected
3. Often runs about or climbs excessively in situations where it is inappropriate (in adolescents or adults may be limited to feelings of restlessness)
4. Often has difficulty playing or engaging in leisure activities quietly
5. Often 'on the go' or acts as if 'driven by a motor'
6. Often talks excessively
7. Often blurts out answers to questions before the questions have been completed
8. Often has difficulty waiting in line or awaiting turn in games or group situations
9. Often interrupts or intrudes on others (e.g. butts into conversations or games)

neurological and neurodevelopmental examination, and obtaining detailed standardised behaviour rating scale data e.g. Conners (Goyette *et al.*, 1978) from at least two sources, usually school and home (American Academy of Pediatrics, 2000). This is scored to determine whether the reported symptoms are statistically deviant relative to normative community data. Many clinicians and most researchers in Australia and North America use the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders 4th Edition – DSM IV (American Psychiatric Association, 1994). This stipulates that a diagnosis of ADHD can only be made if the child exhibits six of the nine defined symptoms in one or both categories of inattention or hyperactivity/impulsivity (*Table 2*). These must have been present since below age 7 years, are observed in at least two settings (i.e. school and home), and have persisted for at least six months (to exclude adjustment reactions to environmental stressors such as parental separation, change of school, death of grandparent etc). In addition the behaviour exhibited by the child must be maladaptive (i.e. causing social, academic or functional impairment) and be present to a developmentally inappropriate degree. All 2-year olds, most 3-year olds and many 4- and 5-year olds are impulsive and inattentive, so clearly the child's behaviour must be evaluated relative to age-related standards for meaningful interpretation. Finally, in order for the symptoms (behaviours) to be ascribed to ADHD other psychiatric disorders such as autism and psychosis need to be excluded.

Natural history

Children with unrecognised or untreated ADHD are at significantly increased risk for a range of negative developmental outcomes. These include academic failure, school dropout, delinquency, unemployment, relationship difficulties, injuries, substance abuse, criminal activity and incarceration (Weiss and Hechtman, 1986). It is believed that early identification of children with ADHD, with early initiation of multi-modal behavioural, academic and even, in some cases, pharmacological therapies will improve the long-term prognosis, however this is yet to be conclusively demonstrated in the few good quality longitudinal studies published (Hechtman, 1999). These studies are extremely difficult to conduct, and the literature is plagued by problems of lack of appropriate controls, confounding therapeutic and environmental influences and poorly documented compliance.

Management

Management of the child with ADHD involves three broad approaches; behavioural, educational and pharmacological (*Table 3*). Many other approaches are commonly applied to these children, including dietary modification, 'natural' or complimentary therapies of diverse types, and behavioural optometry. There is little evidence to support the broad use of any of these interventions, though some individuals report benefits.

Psychostimulant medication is the principal pharmacological therapy for ADHD. Other medications sometimes used in ADHD include the anti-hypertensive clonidine, anti-depressants (selective serotonin re-uptake inhibitors, reversible monoamine oxidase inhibitors, and tricyclics) and occasionally neuroleptics. The use of stimulants to treat

Table 3. General principles of management

- Parent support
- Behaviour modification
  – rewards for acceptable behaviour
  – consequences such as 'time out'
  – withdrawal of privileges for unacceptable behaviour
- Educational interventions
  – classroom adaptations
  – remedial tuition
- Medication
- 'Talking' therapies
  – individual
  – cognitive behavioural therapy
  – family therapy

severe childhood behaviour disturbance was first described in 1937 (Bradley, 1937). Stimulants are believed to work by increasing the amount of catecholamine neurotransmitter in the synaptic cleft, either by increasing the amount of stored neurotransmitter (dopamine) released from the presynaptic neurone or by blocking the post synaptic uptake of the neurotransmitter (Bennett *et al*., 1999). This increases activity particularly in the prefrontal cortex and limbic system, areas associated with attention and arousal.

The psychostimulants are among the most extensively researched medications in paediatrics. The two stimulants most commonly prescribed are methylphenidate (Ritalin) and dexamphetamine. These medications produce significant clinical improvements in approximately 75 per cent of correctly diagnosed children. The primary clinical effects are reduced physical and cognitive impulsivity and improved sustained attention, with secondary effects of increased work output, reduced conflict with family members and peers, and often improved self-esteem over time. Onset of behavioural effect is usually noticeable within 30 to 60 minutes of ingestion. Dexamphetamine has a longer biological half-life than methylphenidate, the clinical effects lasting 4–6 hours (Brown, 1979), compared to 2–4 hours for methylphenidate (Shaywitz, 1982).

There is considerable variation between children in both the optimal dosage and the duration of action of stimulant medication. Therefore prescription regimes need to be individualised based on observed response. Stimulants are commonly given twice a day, in the morning and at lunchtime. However some children may need more frequent dosing (e.g. 8 am, 11 am, 2 pm), whereas for others a single morning dose suffices. The common side-effects are reduced appetite and difficulty falling asleep in the evenings. Many children lose a small amount of weight in the early weeks of treatment, however this is usually regained and normal growth is maintained over time. Less common side-effects include irritability, abdominal pains and headaches. Dexamphetamine has a greater risk of side effects (Efron *et al*., 1997). In some countries the prescription of such stimulant medications is restricted to registered paediatricians and child psychiatrists.

A comprehensive approach to the management of a child with ADHD often involves medication in conjunction with educational and behavioural strategies. The National Institute of Mental Health collaborative Multimodal Treatment Study of Children with ADHD attempted to determine whether the combination of stimulant medication and intensive behavioural treatment is superior to either modality used alone for children with ADHD (combined type). The recently published results from this 14-month trial show that medication +/– intensive behavioural therapy is superior to behavioural therapy alone, but there were no significant additional benefits in terms of core ADHD symptoms when the two modalities were combined (The MTA Cooperative Group, 1999). Modest advantages were however seen with the combination treatment for some important functional outcomes, such as social skills, parent child relations and reading achievement.

The aims of any educational approach are to maximise attention span, try to control impulsive behaviour, assist with learning difficulties and thus raise self esteem. Such programmes may include specific skills training, role-play exercises and the appropriate use of educational aides. Any educational programme is more likely to be successful if supported by behavioural strategies which help promote socially appropriate behaviour e.g. training a child to raise their hand when wanting to speak, appropriate consequences to negatively reinforce inappropriate behaviour, for example, 'time out'. In addition, programmes to assist the child in managing anger and frustration and family support activities may also be useful. Every child with ADHD brings with them a set of individual characteristics. These have to be considered in the development of a management plan suitable for that child.

The dental environment

The visit to a dentist is likely to raise anxiety levels in any child and indeed their parents. In a child with ADHD this anxiety may manifest in overexcited behaviour. Many parents worry about the effect of their child's behaviour on others. They have become accustomed to failure having taken their 'difficult' child to dentists only to be told that it is not possible to provide treatment/care. This may result in either an excessively protective/embarrassed parent with constant apologies on behalf of the child or an overly firm parent exerting inappropriate, heavy-handed disciplinary actions throughout the encounter. In either situation the child's behaviour is likely to be reactive towards the parent thus precluding the establishment of a successful relationship with the dental practitioner.

Successful management of these children may be facilitated in ADHD using similar strategies to those employed in other disabilities (*Table 4*). In general the chance of success is raised if the dental practitioner takes control of the situation early. By creating an atmosphere of confidence

Table 4. Dental management strategies

- Appointments
  - early morning
  - related to peak medication effect
  - short
- Calm and controlled environment
  - early introduction to dental surgery
  - clear, simple instructions
  - ensure good eye contact
  - Tell-Show-Do
- Behavioural modification as used at home and school
  - raising hand to speak
  - 'time out' when inappropriate
- Realistic goal setting
  - consideration of use of general anaesthesia for complex dental treatment
  - toothbrushing charts for homecare

the parental anxiety is often alleviated allowing the child and the dentist to establish a relationship in a more relaxed environment. Likewise a gentle but firm approach will convey to the child a confidence and a structure to the situation within which it is easier for them to conform.

In the dental environment the inability to sit still coupled with the impulsive and unpredictable behaviour can make even a simple examination challenging let alone more complex dental treatment. It is useful for the dental practitioner to have an understanding of the current management strategies being employed by the family at home and in school. For example if a child is used to raising their hand prior to speaking it is useful for the dentist to employ the same strategy. Clear instructions should be given to the child maintaining eye contact throughout and taking care not to over burden the short-term memory. Such instructions need to be given at a time when the child is not distracted by other activities in the dental surgery, for example, the chairside assistant removing instruments or setting up for the next patient.

The use of the Tell–Show-Do method of behaviour direction has been shown to have value in the management of children with ADHD (Felicetti and Julliard, 2000). Praise and encouragement play an important role in the management of these children and good behaviour should be reinforced and rewarded. In addition knowledge of the discipline procedures with which the child is familiar may also assist in allowing the dentist to take control of the sessions in order to optimise the outcomes.

The current medication scheme should be discussed with both the parents and the prescribing practitioner. It is often helpful to either change the dose or the timing of medication to optimise the action at the time of the dental visit. There is also some suggestion that morning appointments may be more successful however this may be related to the timing of medication rather than anything else (Felicitti and Julliard, 2000).

It goes without saying that prevention is essential for these children. Minimising the need for complex restorative treatment will undoubtedly make life simpler. However it is again important to realise that many of these children are already struggling to master other life skills. Brushing their teeth or controlling their diet both require concentration, motivation and understanding all of which can be problematic for the child with ADHD. Toothbrushing charts for the child to take home and mark off daily are more likely to be successful than verbal instructions to brush daily. Repetition is important in building up self-confidence in the child. Multiple short visits have a higher chance of success than single prolonged ones. However it is important to realise that oral health is only one of many priorities for the family of a child with ADHD, and the multiple demands made of the parents need to be weighed against the need for dental care.

Conclusions

ADHD presents a clinical challenge for oral health practitioners. Whether ADHD is increasing is unclear however our understanding of the aetiology and pathophysiology is evolving rapidly. The management of children with this disorder is complex and multifaceted. It is likely that dentists will come across these children increasingly and an understanding of the condition and its management is essential if we are to be successful in promoting good oral health.

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