Clinical
PRACTICE

Overview of Obstructive Sleep Apnea in Children: Exploring the Role of Dentists in Diagnosis and Treatment

Maya Capua, *BSc;* ***Negar Ahmadi,*** *BSc;* ***Colin Shapiro,*** *MBBCh, PhD, MRC Psych, FRCPC*

Contact Author

Ms. Ahmadi

Email: *negar.ahmadi@utoronto.ca*

ABSTRACT

Among the many factors important in children's development is sleep. Sleep disorders can impair children's sleep and lead to negative consequences. Obstructive sleep apnea (OSA), which involves blockage of the airway during sleep, can affect development and behaviour; thus, OSA in children should be diagnosed and treated at an early stage. One of the main causes of childhood OSA is enlargement of the tonsil tissues and, in most cases, their removal serves as an ultimate treatment of OSA. However, it remains unclear what proportion of children with enlarged tonsil tissue suffer from OSA. Dentists are becoming increasingly aware of the issue of OSA as they are sometimes involved in treatment of this condition using oral appliances. Moreover, as dentists often look into children's mouths, they can play an active role in identifying those with enlarged tonsils and referring them for sleep assessment.

For citation purposes, the electronic version is the definitive version of this article: www.cda-adc.ca/jcda/vol-75/issue-4/285.html

Obstructive sleep apnea (OSA) is characterized by repeated episodes of airway obstruction for more than 10 seconds during sleep, resulting in pauses in breathing. OSA is the most common condition among a group of disorders, called sleep-disordered breathing, that can affect both adults and children.

Within the past decade, increasing attention has been paid to OSA among children. Epidemiologic studies have shown that the prevalence of sleep-disordered breathing is about 2% among children[1,2] and about 2.5%–6% among adolescents.[3] OSA in children typically appears between the ages of 2 and 7 years. Although it was thought that boys and girls were equally affected,[4,5] Goodwin and others[6] observed that boys are more likely to have OSA, which is consistent with the tendency for overweight adult males to have OSA.

The gold standard for diagnosis of OSA is overnight polysomnographic testing with measurement of respiratory variables.[7] Apnea hypopnea index (AHI, defined as the number of breathing obstructions per hour) along with oxygen desaturation levels are the main parameters used for diagnosis of OSA. However, the polysomnographic diagnostic criteria for OSA in children are somewhat different from those in adults. Among children, an AHI > 1 and oxygen desaturation ≥ 4% are indicators of mild OSA.[8–10] In comparison, an AHI of 5 (or sometimes 10) among adults generally indicates mild OSA.

Figure 1: Characteristic sleeping position of a child with sleep apnea.

Figure 2: Photo of a child with enlarged tonsils.

Risk factors for development of OSA in children include a family history of snoring or OSA, physical abnormalities, cerebral palsy, muscular dystrophy, Down's syndrome, sickle-cell disease, mouth breathing and any condition that may lead to a narrowing of the upper airway. An important general risk factor for OSA is obesity. According to Tauman and Gozal,[11] recent increasing rates of childhood obesity have led to an increase in the prevalence of OSA among children, as the condition has been shown to be positively correlated with body mass index.

Symptoms of OSA among children include snoring, pauses in breathing while asleep, restless sleep, bizarre sleeping positions (**Fig. 1**), paradoxical chest movements, cyanosis, bedwetting, hyperactivity, stunted growth and disruptive behaviour in school.[11,12] Snoring, which does not alter the sleep architecture, is considered a relatively benign and harmless condition.[13] In contrast, OSA can result in severe complications if left untreated.

Adenotonsillar Hypertrophy as a Risk Factor for OSA

Among children, adenotonsillar hypertrophy is usually associated with OSA, as it involves narrowing of the airway and, consequently, obstruction of the air passage during sleep.[14] Tonsils are small oral masses of lymphoid tissue embedded in the lateral walls of the opening between the mouth and the pharynx. Their function is still uncertain, but they are believed to help protect the body from respiratory infections. Similarly, adenoids are masses of lymphoid tissue situated at the very back of the nose, in the roof of the nasopharynx where the nose blends into the mouth. Normally, in children, adenoids make a soft mound in the roof and posterior wall of the nasopharynx, just above and behind the uvula.

The tonsils and adenoids represent the area of hypertrophy most commonly contributing to airway obstruction.[4] Adenotonsillar hypertrophy refers to the condition where the adenotonsillar tissue expands in size and consequently occupies a larger area in the wall of the nasopharynx (**Fig. 2**). Although it is difficult to estimate the number of children with adenotonsillar hypertrophy due to variations in measurements, a Turkish study[15] attempted to address this issue by measuring the tonsils of 1,784 children from 6 schools. The researchers found that adenotonsillar hypertrophy was more prevalent in boys and according to their scale of 1 to 4 indicating increasing size of tonsils, 3.4% of the population they measured had grade 3 or 4 tonsils.

The increased size of the adenotonsillar tissue is likely to result in blockage of the airway and cause apneic events during the night. OSA may also result from a combination of adenotonsillar hypertrophy and a decrease in muscle tone through the sleep period, particularly during rapid eye movement sleep.[4] Furthermore, physical examination of children with OSA has shown that a large proportion have adenotonsillar hypertrophy.[4] Greenfeld and others[5] found that, contrary to popular belief, OSA due to hypertrophic adenoids and tonsils occurs even in infants (children < 18 months). Moreover, tonsil size has been found to be significantly linked to a higher AHI and, consequently, more severe cases of OSA.[16]

A study by Konno and others[17] reported that during sleep, pediatric patients with enlarged tonsils had an esophageal pressure that was 4–6-fold higher than that of a control group. The researchers explained that this elevation was caused by nasal obstruction due to adenoid hypertrophy. In another study,[18] 22 infants and children with enlarged tonsils were monitored for sleep apnea. All were found to have obstructions during sleep and 21 were found to have obstructive sleep apnea. Six of the 22 patients were clinically diagnosed with failure to thrive.

Consequences of Untreated OSA in Children

As in adults, OSA among children can lead to various adverse health-related consequences. For instance, OSA places increasing strain on the cardiovascular system due to the acute increases in blood pressure and arrythmias associated with apneas and intermittent hypoxia.[19–21] Those who suffer from OSA may snort awake, thus experiencing fragmented sleep. Among children, particularly, OSA can lead to severe developmental problems including failure to thrive, enuresis, attention deficit disorder, behaviour problems, decreased academic performance and cardiopulmonary disease.[4] Johnson and Roth[3] reported excessive daytime sleepiness in children with OSA, and other studies have shown that children with OSA are more aggressive, have higher rates of inattention, are more moody and have impaired visual perception and working memory.[22,23] Chan and others[4] further reported that a large percentage of children with attention deficit hyperactive disorder had underlying sleep disorders including OSA.

In a study by Chervin and others,[24] inattention and hyperactivity were found to be associated with increased daytime sleepiness and, particularly in young boys, there was an association with snoring and other symptoms of sleep-disordered breathing. The large sample size in this study ($n = 866$), as well as the use of questionnaires for both the children and their parents, increases the applicability of these results to general pediatric patients. The results also confirm the findings of other, related studies. According to guidelines published by Schechter,[25] sleep problems in children have been linked to increased risk of hyperactivity and learning problems. Furthermore, Corkum and others[26] found that the relation between sleep problems and attention deficit hyperactive disorder depends on the type of sleep problem as well as the confounding factors.

O'Brien and others[27] found that children with sleep-disordered breathing had significantly lower mean scores on IQ-like tests. In addition, children with sleep-disordered breathing scored significantly lower than a control group on a test of phonological processing, a skill that is very important for literacy. Finally, this study found that total arousal index was negatively correlated with neurocognitive abilities, suggesting a role for sleep fragmentation in sleep-disordered breathing-induced cognitive dysfunction in children. A review by Beebe[22] observed that childhood sleep-disordered breathing was associated with neurobehavioural morbidity. However, the author concluded that a randomized clinical trial is still necessary to assess the long-term effects of remedying the sleep-disordered breathing and to establish a stronger association between the neurobehavioural functioning and sleep-disordered breathing.

Treatment of OSA in Children

Treatment of OSA in children depends largely on the underlying cause of the problem and may include one of the following.

Adenotonsillectomy

Because adenotonsillar hypertrophy is a significant contributing factor to OSA among children, for many, removal of the tonsils is the ultimate treatment of their OSA. In fact, adenotonsillectomy is found to be an effective treatment for up to 80% of children diagnosed with OSA.[28] Chan and others[4] reported that adenotonsillectomy decreased snoring, OSA, weight problems, enuresis and behaviour problems in children with OSA. Elsherif and Kareemullah[29] studied the outcomes among 76 children, aged 3–12 years, with large tonsils or large adenoids (or both) who underwent surgery to relieve upper airway obstruction. These children were studied over 1 year. Following surgery, almost all patients experienced an alleviation of all sleep difficulties, except for enuresis (bedwetting). In conclusion, Elsherif and Kareemullah[29] expressed the strong view that all children with large tonsils should consider adenotonsillectomy as well as a polysomnography recording. Another study found that adenotonsillectomy significantly reduced health care utilization by children with OSA.[30]

Continuous Positive Airway Pressure

The most common nonsurgical treatment for OSA is continuous positive airway pressure therapy. This treatment involves wearing a mask overnight that exerts pressure on the upper airway to prevent collapse. Continuous positive airway pressure is often considered as a treatment for children whose OSA symptoms are not relieved after adenotonsillectomy.

Diet and Medications

For obese children, weight loss and maintaining a healthy diet might prove to be the ultimate treatment for their OSA.[31] Antibiotic medication has been used as a short-term treatment for snoring and obstruction, particularly when these problems are not persistent.[32]

Oral Appliances

Finally, oral appliances, which are provided primarily by dentists, have become increasingly popular within the past few years for treatment of OSA.[33–35] Oral appliances are of particular interest to people who opt not to have surgery and cannot tolerate continuous positive airway pressure treatment. Oral appliances provide effective treatment for many patients and, in one study, were shown to be effective in as many as 50% of patients with OSA.[34]

Researchers investigating the use of oral appliances for children[36–38] have found certain types to be particularly effective in treating OSA. For example, according to Cozza and colleagues,[37,38] a new orthodontic appliance, a modified monobloc, is not only effective in reducing apneic events during sleep, but also improves subjective sleep quality and daytime performance among children.

This use of oral appliances has involved dentists in the treatment of OSA among both adults and children.

Role of Dentists in Diagnosis of Sleep Apnea in Children

Although the prevalence of large tonsils among Canadians is still unclear because of variations in measures and classifications, tonsillectomy is a common surgery. A significant amount of research has been done on children with OSA, measuring their behaviour and attention skills. However, very little research has been done on children with adenotonsillar hypertrophy, regardless of their sleep disorders. For this reason, it would be valuable to clearly establish whether there is a correlation between attention performance and size of tonsils. The implications of such findings could be the basis for the decision to proceed with an adenotonsillectomy. According to Brouillette and colleagues,[18] increasing awareness of OSA and examination of sleeping patients should result in earlier treatment and less morbidity for infants and children with OSA.

As adenotonsillar hypertrophy is one of the main causes of OSA among children, investigating the prevalence of OSA among children with adenotonsillar hypertrophy is an important research question. Although previous studies have looked at adenotonsillar hypertrophy in children suffering from OSA, the reverse question (frequency of OSA among children with adenotonsillar hypertrophy) needs more attention. There is evidence that physicians may not always recognize childhood OSA.[39] According to Konno and colleagues,[17] an average delay of 23 months occurred between identification of pediatric patients with large tonsils and their referral to a sleep clinic. As sleep disorders in children might lead to various behavioural and learning problems, such problems may be misdiagnosed in a child with undiagnosed OSA; identifying and treating children with OSA would significantly benefit several facets of their lives. The first step in this process is to identify children with adenotonsillar hypertrophy, then refer them to a sleep clinic.

Among the physicians treating children, dentists are most likely to identify adenotonsillar hypertrophy; thus, it may be in the patient's best interests if dentists act as "gatekeepers" in identifying children with adenotonsillar hypertrophy (**Fig. 2**). As discussed above, dentists are becoming increasingly aware of sleep apnea in adults, as some are involved in using oral appliances to treat this disorder.[33,40]

Once dentists identify children with adenotonsillar hypertrophy, they should inform the parents about the risk of OSA and further inform their family physician about the importance of sleep assessment in children with enlarged tonsils. Involvement of dentists in this process can contribute significantly to the health of patients, as OSA, with such significant developmental consequences, can be diagnosed and treated at an early stage, preventing later problems and complications.

Conclusions

OSA has significant life-threatening consequences, particularly for developing children. Furthermore, OSA among children can be the underlying cause of behavioural and attentional problems as well as learning difficulties. One of the main causes of childhood OSA is adenotonsillar hypertrophy or enlargement of the adenotonsillar tissue. It is still unclear what proportion of children with adenotonsillar hypertrophy have OSA. However, in many cases, removal of the tonsils has been shown to relieve OSA symptoms. Previous studies have suggested screening children with adenotonsillar hypertrophy for OSA using overnight polysomnography. In identifying and treating OSA among children with adenotonsillar hypertrophy, dentists can play an important role by noting the size of the tonsils when looking into children's mouths and informing the child's parents and the primary care physician when enlarged tonsils are observed.

THE AUTHORS

Ms. Capua *is a research student at the Youthdale Child and Adolescent Sleep Centre in Toronto, Ontario.*

Ms. Ahmadi *is an MSc candidate in the department of cell and systems biology and the Collaborative Program in Neurosciences, University of Toronto, Toronto, Ontario.*

Dr. Shapiro *is a professor in the department of psychiatry. He is also cross-apppointed to the department of ophthalmology and the department of cell and systems biology at the University of Toronto, Toronto, Ontario. He is the director of the Youthdale Child and Adolescent Sleep Centre in Toronto.*

Correspondence to: *Ms. Negar Ahmadi, University of Toronto, Youthdale Child and Adolescent Sleep Centre, 227 Victoria St., Toronto ON M5B 1T8.*

The authors have no declared financial interests.

This article has been peer reviewed.

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