

Sleep Disorders in Pediatric Dentistry: A Hidden Foe

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ABSTRACT

Aim: To review various comprehensive centers on the diagnosis and treatment of sleep-disordered breathing (SDB), highlighting the valuable role that oral appliances can play in managing this disorder.

Background: Obstructive sleep apnea (OSA) is an emerging medical condition that is attracting the interest of healthcare experts. This ailment has been found to impact a considerable portion, approximately 20%, of the population. It is characterized by recurrent episodes of breathing cessation during sleep, followed by brief awakenings. Sleep disorders can significantly impact children's sleep quality among which OSA is the most prevalent. Enlargement of the tonsil stands as one of the primary causes of SDB in children. Surgical removal of the tonsils often serves as an effective treatment for SDB.

Results: The correction of tongue thrusting, speech-related concerns, and abnormal swallowing patterns often necessitates speech therapy, particularly myofunctional therapy. For older children, an occlusal splint can be provided to mitigate bruxism. Various mandibular advancement (MA) appliances are available to prevent or reduce upper airway collapse during sleep. These devices have proven effective in managing the condition OSA for patients who are unable to tolerate surgical interventions.

Conclusion: Dentists are gaining a growing awareness of the significance of SDB and their involvement in treating this condition using oral appliances. Their unique access to examining the oral cavity positions dentists to play an active role in identifying children with enlarged tonsils and referring them for sleep evaluations.

Clinical significance: Dentists, among the healthcare professionals involved in the care of children, are often well-positioned to identify cases of adenotonsillar hypertrophy. Consequently, dentists can play a vital role in recognizing and managing such cases through the use of oral appliances. This becomes particularly relevant for patients who decline surgical options or those with structural abnormalities that can benefit from myofunctional appliances.

Keywords: Myofunctional appliances, Obstructive sleep apnea, Oral appliance therapy, Pediatric, Pediatric dentistry.

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INTRODUCTION

Sleep, a fundamental biological necessity, occupies approximately one-third of our lives. The structure of sleep encompasses two primary forms: Rapid-eye movement (REM) sleep and non-rapid-eye movement (NREM) sleep. The latter can be categorized into three stages: N1, N2, and N3, each representing distinct periods during the nocturnal slumber. The distribution of these stages can vary according to an individual's age. The exploration of gender disparities in sleep remains relatively limited in current understanding.¹

Obstructive sleep apnea (OSA) refers to a breathing disorder characterized by recurrent instances of partial or complete obstruction in the upper airway during sleep. This often leads to disturbances in gas exchange and interruptions in sleep patterns. In the United States alone, OSA affects an estimated 25 million individuals, making it a prevalent form of sleep-related breathing issues.² However, it's important to note that the presentation, diagnostic criteria, progression, and complications of OSA differ significantly between adults and children. Pediatric OSA stands apart from its adult counterpart due to various developmental, physiological, and maturation-related factors that influence respiratory and sleep parameters. The condition is observed in approximately one to five percent of children and can manifest at any age, although it may be more commonly observed in children between the ages of two and seven.³

Among prepubertal children, the occurrence of this condition is roughly equal between boys and girls. However, in adolescents,

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data indicates a potentially higher prevalence among males. It's worth noting that the criteria for defining OSA and sleep-related hypoventilation disorders differ between adults and children. The criteria established for adults can be applied to individuals aged 13–18 years. Timely identification and treatment of OSA can significantly reduce morbidity and enhance quality of life. Unfortunately, the diagnosis of this condition is often delayed, posing challenges to early intervention.⁴

PATHOPHYSIOLOGY

The pathophysiology behind the narrowing of the upper airway during sleep is complex and influenced by multiple factors. Obstructive sleep apnea occurs when the muscles responsible for dilating the pharynx relax, leading to a narrowing of the airway during inhalation. Consequently, this can result in decreased oxygen levels and increased carbon dioxide levels in the bloodstream. Various factors contribute to airway narrowing, including reduced lung volume at the end of exhalation, impaired respiratory drive, a lowered threshold for respiratory arousal, decreased responsiveness of the muscles involved, and an unstable control of ventilation (referred to as high loop gain).⁵

The mechanisms by which apnea and hypopnea resolve are still subject to debate. Respiratory events may cease through the augmentation of upper airway muscle tone triggered by chemical stimuli [such as low partial pressure of oxygen (PaO_2) or high partial pressure of carbon dioxide (PaCO_2), mechanical stimuli stemming from changes in lung volume (related to upper airway mechanoreceptors), or alterations in sleep state (arousal) occurring at either the cortical or subcortical level.¹

Arousals linked to obstructive events lead to fragmented sleep, which can be responsible for excessive daytime sleepiness in older children or adolescents, as well as hyperactivity, behavioral issues, and impaired academic performance in younger children. Consequently, children with untreated OSA may erroneously receive a diagnosis of attention-deficit hyperactivity disorder (ADHD).²

Symptoms of Obstructive Sleep Apnea

- Excessive sleepiness during daytime
- Loud snoring
- Breathing cessation
- Headache in the morning
- Sudden awakening followed by shortness of breath
- Abnormal sleep positions
- Mouth breathing
- Restlessness
- Frequent awakening

School-aged children who have not received treatment for sleep apnea may exhibit various signs and symptoms. These can include nocturnal enuresis (bedwetting), subpar academic performance, aggressive behavior, and delays in development.⁶ If left untreated, sleep apnea can lead to severe consequences, albeit rare, such as brain damage, seizures, coma, and cardiac complications. Additionally, children with OSA may experience impaired growth and development.^{7,8}

ETIOLOGY

In most children, the constriction of the upper air passage is predominantly linked to the enlargement of the adenoids and tonsils. Nevertheless, pediatric OSA can also be connected to a less-than-adequate airway dimension, insufficient neuromuscular control of the airway muscles, or a combination of both factors. Certain patients face an increased risk of developing OSA due to specific anatomical anomalies, craniofacial abnormalities, neuromuscular diseases, or conditions associated with hypotonia. Anatomical anomalies may encompass enlarged tonsils and adenoids, macroglossia (an enlarged tongue), choanal atresia (blockage of the nasal passage), thickening of respiratory tissues

(often caused by conditions like mucopolysaccharidosis), or obesity. Neuromuscular disorders marked by muscle weakness, such as cerebral palsy, myotonic dystrophies, and various myopathies, make children more susceptible to OSA. Furthermore, exposure to environmental tobacco smoke has been linked with an increased risk of OSA.⁹

Sleep Disorders and its Association with Oral Health

Enhancing the quality of sleep, as well as promoting oral health and function involves a comprehensive approach encompassing both understanding the underlying pathophysiology and managing the associated diseases. Sleep disorders can be influenced by the shape and structure of the craniofacial region, thereby impacting oral condition. Hence, altering the maxillofacial framework and enhancing oral functionality can play a vital role in effectively addressing sleep disorders.¹⁰ Dentists play a crucial role in examining the oral cavity to investigate and diagnose potential oral diseases. The oral cavity serves as a reflection of the body's overall health. Sleep, being a fundamental process in the human body, regulates essential biological functions. The quality of sleep reflects an individual's ability to initiate sleep, maintain it, and progress through the various restorative sleep cycles for the requisite duration. Individuals who do not obtain quality sleep may experience a wide range of oral, systemic, and cognitive health issues. Dentists are healthcare professionals entrusted with the responsibility of identifying signs of sleep disorders through oral examination. If any oral indications associated with sleep disorders are detected, as per the guidelines of the American Dental Association, the dentist should refer at-risk patients to appropriate medical specialists such as otolaryngologists, pulmonologists, or sleep medicine physicians. Effective communication between the dentist and these specialists helps determine the most suitable treatment options for each patient.¹¹

Oral Signs and Symptoms

- Bruxism, characterized by teeth grinding, is often the initial indication of sleep apnea. Clenching the teeth can result in the progressive deterioration of tooth structure, breakage, inflammation, and recession of the gums, as well as an increased likelihood of tooth decay due to the excessive force exerted.
- The repeated forward movement of the lower jaw (a protective mechanism triggered by the tongue being positioned towards the back of the mouth, which reduces the airway space) can lead to tooth attrition. Over time, this can impose excessive strain on the temporomandibular joint (TMJ), leading to temporomandibular joint disorders (TMD).
- Tooth mobility can be attributed to occlusal trauma, but it is also influenced by the patient's overall health and the condition of their periodontal tissues.
- Excessive bone loss in areas of tooth mobility can occur locally or diffusely in patients with periodontitis.
- Tongue crenulations, which are scalloped borders along the sides of the tongue, indicate that the patient habitually pushes their tongue forward against the lower teeth in order to open the oral airway.
- An anterior or lateral open bite may develop depending on the position of the tongue.
- Dimpling observed on the functional cusps and lingual or palatal surfaces of the teeth can be a sign of gastroesophageal reflux disorder.



Fig. 1: Mallampati score

- Tongue-tie (ankyloglossia), which limits the range of motion of the tongue, can be associated with a narrow intercanine and intramolar width in the maxillary region, resulting in a high and narrow hard palate.
- Enlarged tonsils and tongue (macroglossia).
- Class II malocclusion, facial profile, and narrow upper arch are interconnected along with convex facial profile. The reduced space in the maxillary arch can restrict the upper airway, increasing the risk of breathing difficulties caused by a collapsed tongue and reduced tongue space, adding to the onset of OSA.

Screening at the Dental Office

To determine whether a child visiting your dental office is at risk of having sleep apnea, there are various factors to consider. By evaluating these factors in combination and gathering information from a clinical examination, along with symptoms reported by the child or their parents, you can screen for pediatric obstructive sleep apnea (POSA).

Currently, there are existing questionnaires that can be used to assess the risk of POSA, such as the pediatric sleep questionnaire (PSQ) or the sleep disorders inventory for school (SDIS). These questionnaires aid in assessing symptoms like snoring, mouth breathing at night, daytime drowsiness, hyperactivity, bedwetting, and obesity. Paying particular attention to habitual snoring (which happens three or more nights per week) is especially relevant when using screening questions.¹²

The clinical examination for POSA risk often includes factors already evaluated during routine dental examinations. Various clinical features associated with an increased risk of POSA include a high Mallampati score (Fig. 1), a high Friedman tongue classification, a high Brodsky score, tonsillar hypertrophy, adenoid facies, micrognathia, retrognathia, a high-arched palate, obesity, and genetic diseases affecting the upper airway (such as Apert, Treacher–Collins, and Down syndromes).⁴

The Mallampati score is a particular assessment utilized to evaluate the relative dimensions of the base of the tongue in relation to the oropharyngeal opening. Its purpose is to predict the likelihood of encountering difficulties when managing the airway.

If a patient is found to have a high risk for POSA based on the assessment, the next step would be to refer them to a medical colleague. While it is currently beyond the dental scope of practice to diagnose sleep apnea, referring the patient to a physician specializing in sleep medicine, if available, can ensure

they receive the best care. The physician may order a sleep study (polysomnography) or sleep apnea test at home (HSAT) to make a definitive diagnosis. The specific testing method will depend on state laws and the availability of pediatric sleep labs.

Before making a referral, it is important to check if the health center or office accepts pediatric patients and at what age they provide services. It's worth noting that there is a limited number of pediatric labs capable of testing this population, and the testing process can be inconvenient and costly for the patient.⁹

Diet and Medications

In the case of obese children, achieving weight loss and adopting a healthy diet can be considered the primary treatment approach for their OSA. These lifestyle modifications can have a significant impact on alleviating the condition.⁴

For cases where mild or residual OSA persists after surgery, additional treatment options are available. Antibiotic medication, topical intranasal corticosteroids, leukotriene receptor antagonists, and anti-inflammatory therapy can be utilized as complementary measures. These interventions aim to address the remaining symptoms and optimize the overall management of OSA in these children.

Sleep Bruxism and its Relation to Sleep Disordered Breathing (SDB)

Sleep bruxism, also known as SB, is a distinctive motor disorder marked by the presence of rhythmic activity in the muscles involved in chewing, specifically the masticatory muscles. This condition is closely associated with the grinding of teeth, referred to as tooth grinding (TG), as well as sporadic instances of clenching the teeth together. A panel of esteemed experts from across the globe recently conducted a comprehensive review of the definition of bruxism. This revised definition has been subsequently accepted and incorporated into the upcoming online publication of the International Classification of Sleep Disorders-3, scheduled for release in 2013.²

Previously, there has been a suggestion of a connection between sleep bruxism (SB) and SDB. However, it remains to be established whether these two phenomena are merely coincidental, intricately linked in a cause-and-effect relationship, influenced by arousal reactivity, or associated with a particular physiological state that triggers either one or the other.

There are potential clinical outcomes that may be associated with sleep bruxism, although it should be noted that not all of them have been definitively established. They are listed below as:

Dental

- Significant wear and tear on the occlusal and incisal surfaces of the teeth, commonly referred to as severe occlusal and incisal wear or chipping, can lead to tooth fracture and attrition over time.
- Tooth mobility
- Teeth hypersensitive to cold or hot
- Cracked tooth syndrome

Temporomandibular Disorders

- Masticatory muscle hypertrophy
- Muscle discomfort because of fatigue
- Stiff and tight mandible
- Joint discomfort and pain

Other

- Tongue indentations on the lateral border
- Reduced salivary flow (Xerostomia)
- Biting of cheek, lip, or tongue
- Glossodynia

Significant wear and tear on the occlusal and incisal surfaces of the teeth, commonly referred to as severe occlusal and incisal wear or chipping,¹³ can lead to tooth fracture and attrition over time.

If you experience teeth grinding, the current standard of care advises undergoing a sleep study as it is probable that you are experiencing episodes of disrupted breathing throughout the night, depriving yourself of the numerous health advantages associated with deep-stage sleep. Even if you are in good overall health, it is well-established that sleep apnea substantially elevates the risk of developing conditions such as high blood pressure, stroke, cancer, diabetes, depression, and obesity. According to the National Sleep Foundation, around 25 percent of individuals with OSA also suffer from sleep bruxism. There are several theories proposed to elucidate the connection between OSA and bruxism. One theory suggests that when individuals awakened from episodes of sleep apnea, the cardiovascular and respiratory systems release stress hormones, prompting the jaw to clench and engage in grinding. Another theory emphasizes the role of airway instability during apnea episodes or snoring, which triggers a signal prompting the jaw muscles to tighten.¹³

Dental Treatments

Nonsurgical dental treatments for POSA include rapid maxillary expansion (RME), mandibular advancement (MA), and myofunctional therapy. Rapid Maxillary Expansion is a fixed intraoral device that widens the upper jaw by separating the mid palatal suture, mainly expanding the nasal cavity and hard palate. By increasing the transverse skeletal relationship, RME can improve airway volume, especially in younger patients with a high, narrow palate and crossbite. Mandibular advancement appliances redirect the early growth of the mandible to a more forward position. These functional appliances can be used in combination with myofunctional therapy, including Herbst, twin bloc, bionator, and Frankel appliances.¹⁴

Myofunctional therapy encompasses oral complex-strengthening exercises typically performed by professionals such as speech-language pathologists, hygienists, dentists, or physicians. The therapy aims to improve the tone and function of muscles in the tongue, lips, soft palate, and lateral pharyngeal wall.

Myofunctional therapy originated from reports that strengthening oral complex muscles through playing the didgeridoo (a musical instrument used by Aboriginal peoples of northern Australia) reduced the severity of OSA. Subsequent studies have shown that consistent performance of myofunctional exercises can reduce the severity of POSA.

In cases of severe POSA that significantly impacts quality of life or when dealing with genetic craniofacial syndromes, craniofacial surgery may be considered as an option to avoid tracheostomy. Surgical procedures can involve hyoid expansion, skeletal expansion, or modified maxillomandibular advancement.¹⁵

It's important to note that the effectiveness of these treatments may vary depending on the individual, and further research with larger sample sizes is needed to establish specific guidelines for orthodontic treatment of POSA. Consulting with a dental professional and collaborating with other medical specialists is crucial to determine the most suitable treatment approach for each patient.

Role of a Pediatric Dentist

Dentists play a crucial role in identifying patients who are at risk for OSA and other sleep-related breathing disorders (SRBD). Their contribution in recognizing these conditions is widely recognized and comparable to that of physicians.

Within the realm of healthcare providers specializing in pediatric care, dentists are particularly adept at identifying cases of adenotonsillar hypertrophy in children. As a result, it may be highly advantageous for dentists to assume the role of "gatekeepers" in recognizing children with this condition. Moreover, as previously mentioned, dentists are increasingly recognizing the presence of sleep apnea among adults and are actively engaged in utilizing oral appliances (OAs) to address this disorder.¹⁴

Once dentists identify children with adenotonsillar hypertrophy, it is imperative that they promptly inform the parents about the potential risk of OSA. Additionally, they should emphasize the significance of conducting sleep assessments for children with enlarged tonsils to the family physician. By actively participating in this process, dentists can significantly contribute to the overall well-being of their patients. The timely diagnosis and treatment of OSA, a condition with far-reaching developmental implications, can be accomplished at an early stage, thereby averting future complications and associated challenges.

The dentist's role in the treatment of SRBDs includes the following:

- Dentists are urged to incorporate the screening of patients for sleep-related breathing disorders (SRBD) into their comprehensive medical and dental assessments. This involves recognizing symptoms such as excessive daytime sleepiness, choking episodes, snoring, or observed breathing pauses. Additionally, dentists should evaluate potential risk factors including obesity, retrognathia (a condition where the lower jaw is positioned farther back than normal), or hypertension. If necessary, these patients should be referred to the relevant physicians for a thorough diagnosis.
- The utilization of oral appliance therapy is considered a suitable treatment option for individuals with mild to moderate sleep apnea. It is also an alternative for those with severe sleep apnea who are unable to tolerate continuous positive airway pressure (CPAP) treatment. In the case of children, a thorough screening process involving medical history and clinical examination

can help identify indications of inadequate growth and development, as well as other risk factors that may contribute to airway problems.

The pediatric dentist, along with the otolaryngologist, plays a crucial role in detecting pediatric obstructive sleep apnea syndrome (OSAS). Often, the pediatric dentist is the first healthcare professional to examine the child and can clinically identify risk factors that raise suspicion of apneic episodes. Furthermore, it is recommended that all children previously diagnosed with OSAS also receive an evaluation by a pediatric dentist. This evaluation focuses on dental-related factors that are associated with the occurrence of apneic episodes. By doing so, a cause-guided treatment approach can be established to effectively address the condition.^{15,16}

CONCLUSION

Sleep-disordered breathing is a prevalent condition among children. Its impact on a child's growth and development can have adverse effects on their overall health, neuropsychological well-being, quality of life, and future economic potential. Therefore, it is essential to recognize SDB in children as a significant public health concern, just as it is acknowledged in the adult population. When it comes to identifying and treating OSA in children with adenotonsillar hypertrophy, dentists play a crucial role. They can assess the size of the tonsils during oral examinations and notify the child's parents and primary care physician when enlarged tonsils are observed. This proactive involvement by dentists helps in early detection and prompt communication, contributing to the effective management of the condition.

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