PEDIATRIC DENTISTS AS GATEKEEPERS FOR PEDIATRIC OBSTRUCTIVE SLEEP APNEA: A NARRATIVE REVIEW – PART 1

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NARRATIVE REVIEW

ABSTRACT

"A good night sleep is very important for good health", but many children are divested of sleep due to Sleep Disordered Breathing (SDB). SDB is defined as a clinical spectrum of repetitive episodes of complete or partial obstruction of the airway during sleep. This disorder consists of Obstructive Sleep Apnea (OSA), characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts normal ventilation during sleep and normal sleep patterns. Disruptive sleep pattern may affect the child's general and social well-being. The first part of this review explores the literature between 1980 to 2014 on pediatric obstructive sleep apnea (POSA) that helps in narrating the early diagnosis and treatment interventions that are important to improve child's long-term cognitive development, social interaction, academic achievement, cardiovascular health and overall wellbeing.

Keywords: Obstructive Sleep Apnea, Sleep Disordered Breathing, Pediatric Dentistry, Myofunctional Therapy

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INTRODUCTION

The American Academy of Pediatrics defines Obstructive Sleep Apnea (OSA) as a "disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or

intermittent complete obstruction that disrupts normal ventilation during sleep and normal sleep patterns".[1]

Obstructive sleep apnea syndrome (OSAS) was first reported in children by Guilleminault et al. (1976).[2] Epidemiologic studies have shown that the incidence of sleep-disordered breathing (SDB) is about 2% among children and about 2.5%– 6% among adolescents. Symptoms consistent with risk for SDB have been reported in 6% to 27% of children.[3]

Pediatric obstructive sleep apnea (POSA) in children typically appears between the ages of 2 and 7 years.[4] OSA has a bimodal age of occurrence with the first peak coinciding with the developmental peak of adenotonsillar hyperplasia (2-5 years). The second peak appears in middle to late adolescence.[5,6] Goodwin et al observed that boys are more likely to have OSA, which is consistent with the inclination for overweight adult males to have OSA.[7]

Children with SDB use greater healthcare resources and display more frequent cardiovascular morbidity, neurocognitive, metabolic complications, comorbid chronic illnesses, greater psychiatric and behavioral comorbidities some of which may have long-term implications, well into adulthood.[5,8-13] Therefore, early diagnosis and treatment of pediatric OSAS is imperative.

ETIOLOGY

Risk factors for development of OSA in children includes a family history of snoring or OSA, physical abnormalities, cerebral palsy, muscular dystrophy, Down syndrome, sickle-cell disease, mouth breathing and any condition that may lead to narrowing of the upper airway.[3]

An important general risk factor for OSA is obesity who increasing rates in childhood have led to an increase in the prevalence of OSA among children.[14]

Increased upper airway resistance during sleep in children with OSA is most likely due to a combination of soft tissue hypertrophy, craniofacial dysmorphology, neuromuscular weakness or obesity. The association between maxillofacial malformation and malocclusion to OSA has triggered more interest. Most common facial anatomic abnormalities associated with airway obstruction include deviated nasal septum, narrow maxillary arch and retro-micrognathia.[15,16]

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Owing to its multifactorial etiology, the pathophysiology of OSA has been simplified in Figure 1.[17-20]

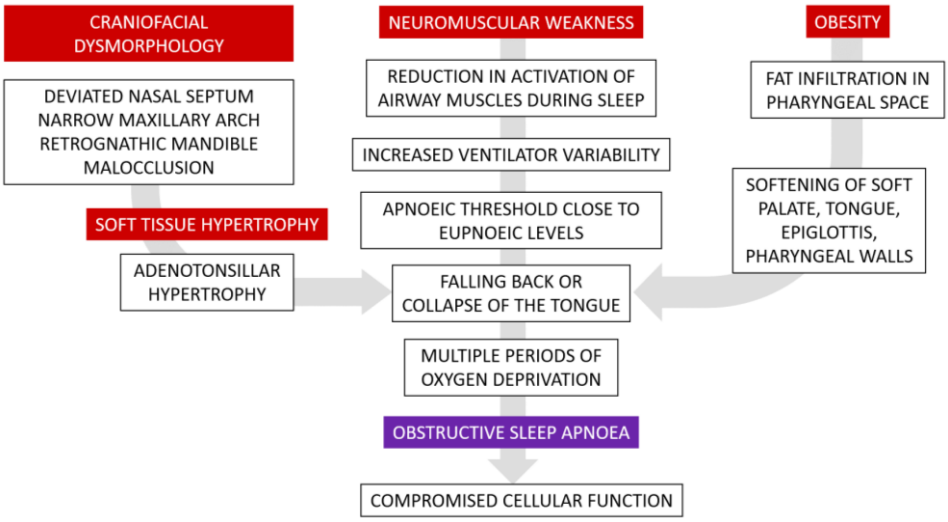

Figure 1 Pathophysiology of OSA

SYMPTOMS OF POSA

Symptoms of POSA include snoring, pauses in breathing while asleep, restless sleep, bizarre sleeping positions, paradoxical chest movements, cyanosis, bedwetting, hyperactivity, stunted growth and disruptive behaviour in school. Snoring, which does not alter the sleep architecture, is considered a relatively benign and harmless condition.[21,22]

COMPLICATIONS OF OSA	
SYSTEM	**EFFECT**
Cardiovascular	Increased blood pressure
Depression	Mood swings
Psychological	Increased vulnerability to attention-deficit hyperactivity disorder (ADHD)
Respiratory	Acidosis due to carbon-dioxide accumulation which also affects Growth Hormone Forced respiration results in deficiency of calories and leads to failure to thrive

Table 1 Complications of OSA

DIAGNOSIS

The American Academy of Pediatrics (AAP) has established clinical guidelines for better recognition and management of young patients with OSA (Figure 2).[21]

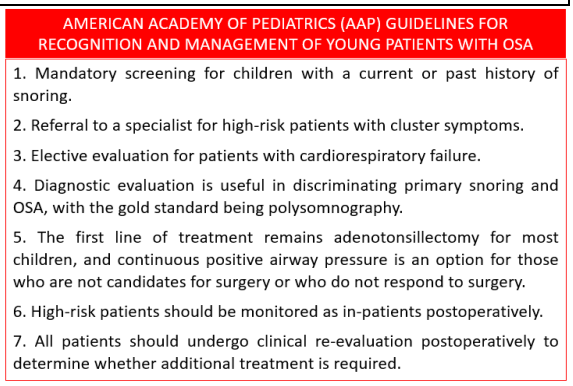

Figure 2 AAP Guidelines for OSA

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The gold standard for diagnosis of OSA is overnight polysomnographic testing with measurement of respiratory variables.[22] Registered Polysomnographic Technologist (RPT) are the technicians that are authorized to conduct this procedure.

According to the American Academy of Sleep Medicine, a sleep study generates several records of activity during several hours of sleep [Table 2].

PARAMETERS RECORDED DURING A SLEEP STUDY	
Parameter	Function
Electroencephalogram	Measures brain activity
Electro-oculogram	Measures eye and chin movements
Electrocardiogram	Measures heart rate and rhythm
Chest Bands	Respiration
Pulse Oximeter	Measures blood oxygen and carbon-dioxide levels
Leg movements	Measured during different stages of sleep
POLYSOMNOGRAPHY INFERENCE	
Apnoea	Any pause in respiration lasting longer than two breaths
Hypopnea	Reduction of airflow by 50% for two respiratory cycles accompanied by reduction of saturation by 3% or arousal from sleep
Apnea-Hypopnea Index	Number of breathing obstructions per hour along with oxygen desaturation levels Inference Mild: AHI score between 5 and 15 Moderate: AHI score between 15 and 30 Severe: AHI score >30 Among children, an AHI score more than one and oxygen desaturation more than 4% are indicators of mild OSA.

Table 2 Parameters recorded during a sleep study

CLINICAL EXAMINATION BY PEDIATRIC DENTIST

1) CHECK FOR ENLARGED ADENOIDS AND TONSILS

a) Using the Mallampati Scale

Mallampati Airway Classification (I – IV scale) is a non-invasive procedure and can be easily mastered and assessed. During the examination, patients are asked to open their mouth as

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wide as possible and also protrude their tongue simultaneously. Patients are instructed not to emit any sound during the examination.

Nuckton et al stated that on an average, for every 1 point increase in the Mallampati score, the odds of having OSA increased more than 2-folds and the AHI increased by more than 5 events per hour.[23]

The Mallampati scale is as follows:

Class I – Soft palate and entire uvula is visible

Class II – Soft palate and portion of uvula is visible

Class III – Soft palate visible (may involve base of uvula)

Class IV – Soft palate not visible

b) Radiographic Examination

Assessment of enlarged adenoids, tonsils and reduction in the pharyngeal space can be done with the help of a lateral cephalogram while assessing pharyngeal space.

2) ASSESSMENT OF HARD TISSUE STRUCTURES

Presence of high and narrow hard palate, overlapping incisors, crossbite and overjet which are indicative of micrognathia or abnormal maxilla-mandibular growth

3) ASSESSMENT OF THE NOSE

Nose should be checked for asymmetry, deviated nasal septum, enlarged adenoids, collapse of nasal valves during inspiration.

TREATMENT MODALITIES

Management of OSA can be surgical or nonsurgical depending upon the potential contributing factors identified by the history, clinical examination, investigations and severity of the patient's condition.

1) SURGICAL PROCEDURES

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a) Adenotonsillectomy

The goal of this conventional surgical procedure is to remove the obstruction by resection of all the lymphoid tissue of the tonsils. Adenotonsillectomy is found to be an effective treatment for up to 80% of children diagnosed with OSA. This procedure helps in improving both daytime and nighttime clinical symptoms such as snoring, sleep apnea attacks and mouth breathing after adenotonsillectomy in children.[24,25]

b) Maxillofacial surgeries

A variety of procedures have been developed to enhance upper-airway patency during sleep in patients with obstruction at, or below the base of the tongue. These procedures involve genioglossal advancement, with or without resuspension of the hyoid bone. This is a multidisciplinary procedure which can be performed in conjunction with an uvulopalatopharyngoplasty by an otolaryngologist and an oral surgeon.[26] These procedures should be reserved for patients with sleep apnea who are either unwilling or unable to be treated with positive airway pressure (e.g. craniofacial abnormalities).

2) NON-SURGICAL PROCEDURES

a) Continuous Positive Airway Pressure (CPAP)

Since its initiation in 1981, CPAP has become the gold standard treatment for OSA. CPAP therapy is indicated in children with specific surgical contraindications, minimal adenotonsillar tissue, or persistent OSA after adenotonsillectomy. This treatment involves wearing a mask overnight that exerts pressure by acting as a pneumatic splint on the upper airway to prevent collapse. CPAP has better tolerance in older children and requires frequent clinician assessment of adherence and efficacy.[27]

b) Diet, Weight Loss and Medications

For obese children, weight loss and maintaining a healthy diet might prove to be the ultimate treatment for their OSA. Antibiotic medication has been used as a short-term treatment for snoring and obstruction, particularly when these problems are not persistent.[27,28]

c) Oral Appliances

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Oral appliances are of particular interest to people who opt not to have surgery and cannot tolerate continuous positive airway pressure treatment. Removable oral appliances are an alternative treatment option for patients with OSA and mandibular retrusion. As of 2014, the most effective oral appliances are the ones that are designed to hold the mandible in an anterior position (protrusion). The mandibular advancement splint reduces upper airway collapsibility during sleep and increases the total airway volume.[29,30]

Rapid maxillary expansion (RME) is a dentofacial orthopedic treatment procedure commonly adopted in young patients for the treatment of constricted maxillary arches. RME may relieve nasal breathing problems by increasing the transverse dimensions of the maxilla, which in turn widens the nasal cavity.[31,32] Furthermore, a modified monobloc, is not only effective in reducing apnoeic events during sleep, but also improves subjective sleep quality and daytime performance among children.[33]

Tongue retainers are another class of oral appliance that are designed to keep the tongue in an anterior position during sleep. These devices secure the tongue by means of negative pressure in a soft plastic bulb. A flange, which fits between the lips and teeth, holds the device and tongue anteriorly in the oral cavity. It should be noted that these devices also modify mandibular posture, at least by downward rotation.[34]

NoSnores™ Appliance is an appliance that is a type of mandibular advancement device which is more comfortable than CPAP, easy to mould, and is portable. This appliance is custom-fitted by being first immersed in hot water for 20 seconds, and inserted into the mouth with the contours facing upward. The patient should bite gently and push the device with their hand to get a perfect fit. The appliance is then placed in cold water for 2 minutes to make the mould permanent. The air flow hole insert is then removed.[35]

d) Myofunctional exercises (ME)

ME for training the orofacial musculature can help in repositioning the tongue, improve the tonicity of muscles of mastication, and facilitate nasal breathing. The interested clinician can read in detail about ME for OSA as described by Guimaraes et al.[36]

Guilleminault et al. evaluated 24 children who were cured by the combination of adenotonsillectomy and palatal expansion (AHI 0.4 ± 0.3). 11 children received ME (intervention group) and 13 children did not receive ME (controls). After a 4-year follow-up,

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the children who practiced MT over a longer period of time remained cured of OSA (AHI 0.5 ± 0.4), compared to children who were never trained to perform the exercises. These children subsequently had a recurrence of OSA (AHI 5.3 ± 1.5/h).[37]

CONCLUSION

POSA can have detrimental effects on the general health, neuropsychological development and quality of life of the child if left untreated. The informed pediatric dentist can play a significant role in the initial diagnosis, suitable referral, and supportive therapy for children.

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