Chapter 264

The role of orthodontics in obstructive sleep apnea and Hypopnea Syndrome in children

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ABSTRACT
Orthodontics often comes across mouth-breathing patients whose cause of upper airway obstruction consists of hypertrophy of the pharyngeal or adenoid tonsils and/or palatine tonsils. The effects of mouth breathing on craniofacial growth are characterized by maxillary atresia with the deep palate and the expression of preponderant growth in the vertical direction, and anterior open bite and mandibular retrusion may occur. After the referral and the evaluation/performance of the otorhinolaryngologist, the procedure of rapid expansion of the maxilla is indicated, in addition to the other procedures according to the orthopedic/orthodontic problem presented. Often, the performance of the speech therapist becomes necessary and important for the maintenance of the results obtained with the treatment performed by orthodontics. However, despite conducts already readily established in the daily life of orthodontic professionals, this chapter deals with a health condition that may be associated with the mouth-breathing child, which is Obstructive Sleep Apnea and Hypopnea Syndrome (OSAHS) and that many professionals are still unfamiliar with. Disease screening allows for a more efficient and complete approach to the patient's problem by all professionals involved.

Keywords: Obstructive sleep apnea, Intraoral appliance, Children.

1 INTRODUCTION

The relative number of overweight or obese people in the world population, due to inadequate eating routines and poorly planned school and/or professional activities, brings a future scenario of concern. It is known that obesity is associated with the main causes of morbimortality, such as cardiovascular diseases, and chronic diseases, such as diabetes mellitus. However, few people in the population know or have heard of other associations of obesity, such as obstructive sleep apnea and hypopnea syndrome (OSAHS), and its consequences. Although this syndrome occurs more frequently in obese people, it can also affect other people regardless of weight, especially in children, but obesity is an aggravating risk factor. OSAHS is a respiratory disorder that if left untreated can lead to serious health impairments and even death (depending on the severity). It affects any age group, being more reported in adult and elderly patients, but that in children often seems to go unnoticed and which demonstrates the need for greater dissemination and attention to the problem, considering that the child is in a frank process of general development. Thus, this

chapter aims to provide general information about this clinical picture in children and its approach by dental professionals.

2 OBSTRUCTIVE SLEEP APNEA AND HYPONEA SYNDROME IN CHILDREN

OSAHS represents the most severe picture of obstructive sleep respiratory disorder. In this syndrome, both hypopnea, characterized by a partial obstruction of the pharynx during sleep, and apnea, with complete obstruction and interruption of air passage at some moments during sleep, may occur(1,2).

The prevalence in children of this syndrome varies between 2-10%, depending on the population studied, and with a considerable increase in obese children (2–4). The most frequently affected age group is between 2 and 8 years of age, regardless of gender. However, male children show a higher risk than female children after puberty (4,5).

According to the *American Academy* of *Pediatrics*, the evaluation of problems of this nature should be part of the routine of professionals who serve children, because often parents may not perceive or do not consider as a major problem in the quality of their children's sleep. Children with OSAHS often do not present a quality of life and may develop cardiovascular problems, neurobehavioral deficits, and other future impairments (3–5).

Although the pathophysiology is multifactorial in children, the most common etiological factor is upper airway obstruction(2–5). Figure 1 shows the anatomical structures related to the upper airways, starting from the nose to the region of the laryngopharynx (lower border of the cricoid cartilage) and divided into nasopharynx, mouth, or oropharynx and laryngopharynx. The most common obstruction of these pathways consists of hypertrophy of the pharyngeal or adenoid tonsils (nasopharynx) and the palatine tonsils (bucopharynx) (Figures 2 and 3).

Figure 1 – Upper airways (Source: Adapted from the Image of Alessandra Alê by Pixabay)

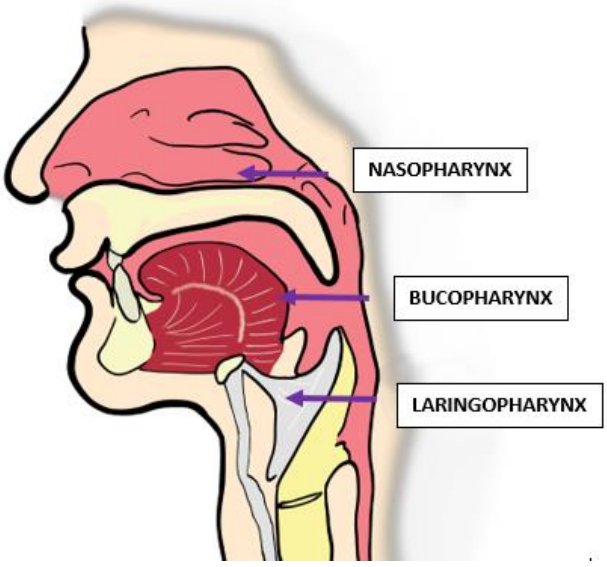


Figure 2 – Hypertrophic palatine tonsils (Source: authors' file)

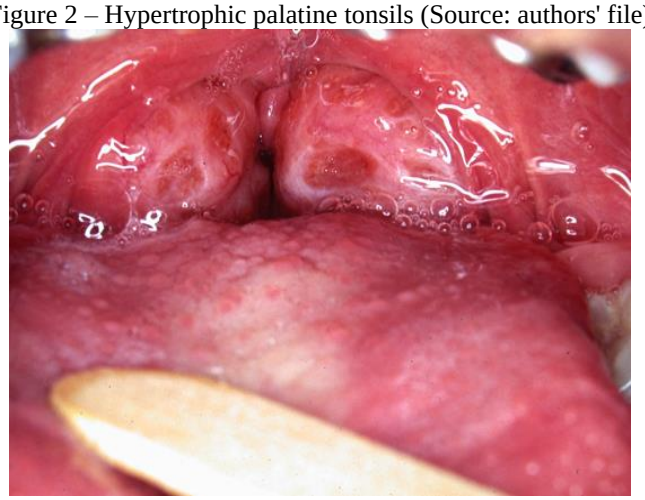
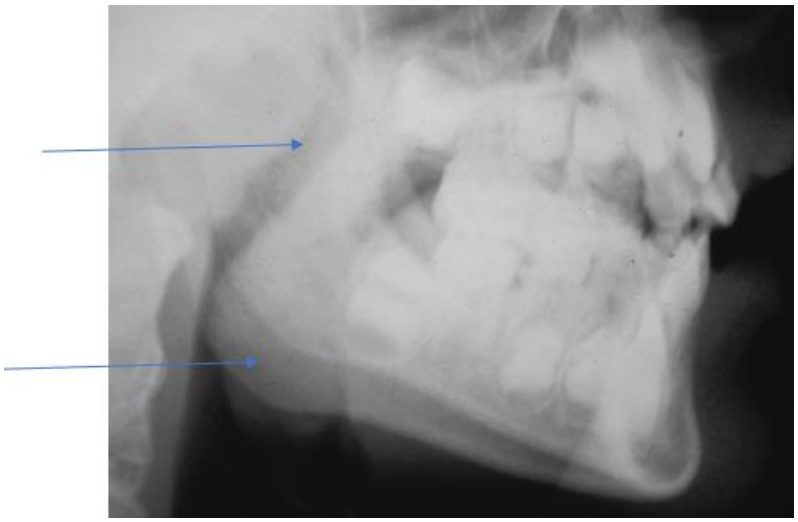


Figure 3 – Inferior view of a lateral t-elerradiography, demonstrating the presence of obstruction of the upper airways (Source: authors' file)



The presence of this obstruction causes the child to breathe through the mouth all the time. In this way, the developing face acquires an aspect called adenoideana face, that is, a long face, without passive lip sealing (hypotonia of the orbicularis of the lips and eversion of the upper lip) and dark circles due to the difficulty of sleeping. Often, changes in the development of the jaws can be observed, especially in the maxilla such as maxillary atresia and the deep palate. In these more severe cases, surgical removal is indicated, however, children with OSAHS can demonstrate 40-75% of some level of the disease even after surgery (3).

3 DIAGNOSIS OF OSAHS

It is important to consider that apnea can have a central, obstructive, and mixed origin (4). Although this chapter deals with obstructive apnea, the other possibilities should not be disregarded. The diagnostic approach is usually performed by the medical professional (2), however, the screening and the appropriate referral should be performed by every health professional.

4 CLINICAL FEATURES

Typical symptoms of OSAHS are snoring unrested sleep and daytime hyperactivity. Unlike adults who have daytime sleepiness, children usually have some irritability and even aggression during the day. Parents usually report that sometimes it becomes necessary to shake the child for the return of normal breathing during sleep. Sweating and nocturnal enuresis may occur (2). By agitation and daytime inattention, the symptoms can be confused with attention deficit and hyperactivity, leading to inadequate treatments (5). Sometimes, bruxism may be present in patients with OSAHS (2). Chart 1 lists the signs and symptoms of OSAHS.

Chart 1 – Signs and symptoms of obstructive sleep apnea and hypopnea syndrome (OSAHS)

SIGNS AND SYMPTOMS OF OSAHS
Clinical history
• Frequent snoring (> 3x/week)
• Difficult breathing during sleep
• Choking/breathing noises/episodes of apneas observed
• Enuresis and night sweats
• Sleep in the sitting position or with cervical hyperextension
• Cyanosis
• Headache upon awakening
• Learning disability
• Attention deficit/hyperactivity disorder
• Gastric reflux
Physical examination
• Adenotonsillar hypertrophy
• Adenoid face
• Micrognathia/retrognathia
• Ogival palate
• Failure to thrive
• Systemic arterial and pulmonary artery hypertension (up to extreme *cor pulmonale*)

Source: adapted from MAAHS; ALMEIDA, 2016, p.221(5)

The risk factors, besides obesity, are the skeletal discrepancies between maxilla and mandible and craniofacial disorders, neurological and genetic (3). However, in contrast to adults, children with OSAHS tend not to be obese, which draws more attention to the problem (5).

5 COMPLEMENTARY EXAMINATIONS

The presence of clinical signs and symptoms requires diagnostic complementation. One of the tools used by dentists and specifically by orthodontists is the cephalomradiographyistrica (teleradiography in lateral norm) and even the computed tomography of cone beam (6). These exams allow the evaluation of upper airway obstruction, specifically in the nasopharynx region and in the bucopharynx, detecting the presence of hypertrophic tonsils (Figure 3). From this and before the orthodontic intervention of the malocclusion, the patient should be referred to the otorhinolaryngologist for a more accurate evaluation of mouth breathing and its causes. However, it is by polysomnography that the diagnosis of apnea and hypopnea can be verified.

Nocturnal polysomnography is considered the gold standard for the diagnosis of OSAHS. And this examination, performed in hospitals or sleep medicine clinics, makes it possible to evaluate the presence of apneas and hypopneas in events per hour, determining the severity of the case, in addition to other associated respiratory, cardiovascular, and neuromuscular parameters. The *Association of Sleep Medicine* has published a guideline on the parameters to be monitored during polysomnography. Thus, information such as the Index of Apnea and Hypopnea (AHI) is obtained, which represents the number of events per hour and establishes the severity according to this number. Mild OSAHS is considered when the AHI is between 1 and 4.9; moderate between 5 and 9.9; severe >10 and very severe > 30 events/hour. However, although it is the test of choice for the diagnosis of OSAHS and used as a parameter for treatment planning in adults, in children, according to the *American Academy of Otolaryngology-Head and Neck Surgery*, this test is indicated for special conditions such as children under 2 years of age, obese children, with Down syndrome or other syndromes, craniofacial abnormalities, neuromuscular diseases, sickle cell anemia and mucopolysaccharidosis (5). However, the American Academy of *Sleep Medicine*, the *American Academy of Pediatrics*, and the *European Respiratory Society* recommend polysomnography in children when OSAHS is suspected. Even because, polysomnography allows us to interpret the origin of the apnea, if of central, obstructive, or mixed origin, and, consequently, will influence the treatment approach and the preservation of the same (3).

Other diagnostic approaches are suggested in the literature, such as the use of oximeters at night (7) and the use of validated questionnaires. However, there is a tendency to underdiagnose OSAHS cases with nocturnal oximetry, especially in children with frequent awakenings and constant movements during sleep (5). Among the questionnaires, the *Pediatric* Sleep *Questionnaire* (PSQ) and the *Sleep Clinical Record* (SCR) present the convenience of following the recommendations of the *European Respiratory Society Task Force* (8,9). The most widely used screening for OSAHS in children is the PSQ, published by Chervin et al. (10) in 2000. According to these authors (10), the PSQ questionnaire presents 22 questions aimed at children aged 2-18 years, with suspicion of OSAHS. This questionnaire must be answered by the child's guardian and is divided into 3 domains: snoring, drowsiness, and behavior. Each "yes" answer scores 1 and each "no" or "don't know" answer scores 0. Thus, in the validation performed compared with polysomnography, a value of 8 or more positive responses would be indicative of a probable OSAHS. Recently, this questionnaire was translated and adapted for the Portuguese of Brazil, demonstrating a high sensitivity of 0.92 and high specificity of 1.0 (9). Table 2 reproduces the final translation of the PSQ questionnaire.

Table 2 - PSQ questionnaire translated into Portuguese (Brazil)

PSQ – version in Portuguese Brazil	YES	NO	I DON'T KNOW
DURING SLEEP, YOUR CHILD:	( )	( )	( )
A1- snores more than half the time	( )	( )	( )
A2 – always snoring	( )	( )	( )
A3- snore loudly	( )	( )	( )
A4- has deep or noisy breathing	( )	( )	( )
A5- Do you have difficulty breathing or struggle to breathe?	( )	( )	( )
S6 – Have you ever seen your son (or daughter) stop breathing in their sleep?	( )	( )	( )
YOUR CHILD:	( )	( )	( )
A7- tends to breathe with the mouth open during the day	( )	( )	( )
A8- wakes up with a dry mouth	( )	( )	( )
A9- pee in bed from time to time	( )	( )	( )
YOUR CHILD:	( )	( )	( )
B1- wake up tired in the morning?	( )	( )	( )
B2- Do you have a problem with drowsiness during the day?	( )	( )	( )
B3- Has any teacher or other person ever commented that your child seems sleepy during the day?	( )	( )	( )
B4- Is it difficult to wake your child in the morning?	( )	( )	( )
B5- Does your child wake up with a headache in the morning?	( )	( )	( )
B6- Has your child stopped growing normally at some point since birth?	( )	( )	( )
B7- Is your child overweight?	( )	( )	( )
YOUR CHILD OFTEN:	( )	( )	( )
C1- Doesn't seem to listen when they talk directly to him	( )	( )	( )
C2-Has difficulty organizing tasks and activities	( )	( )	( )
C3—Is easily distracted by other people's stimuli	( )	( )	( )
C4—Gets restless hands or feet or becomes agitated when sitting	( )	( )	( )
C5—Does not stop quiet or often acts as if it is plugged into the outlet	( )	( )	( )
C6- Interrupts people or intrudes on conversations or rants	( )	( )	( )

Source: Reproduction of Martins *et al.*, 2022, p.S66 (9)

6 DENTAL APPROACH

Given the history presented, the signs and symptoms suffered and the presence of upper airway obstruction, invariably the dental professional refers the patient to the otorhinolaryngologist requesting an evaluation of mouth breathing. However, in addition to analyzing the consequences of mouth breathing in the context of the development of the jaws, that is, of malocclusion, it is recommended as a form of screening for OSAHS to perform the questionnaire, such as the *Pediatric Sleep Questionnaire*, which may add important information for the conduct of the clinical case (Chart 2) (10).

The most common cause of OSAHS in children is hypertrophy of the pharyngeal and palatine tonsils and in this case, surgical removal of both by the otolaryngologist is often performed and successfully in severe cases. Even so, 33-7 6% of obese children can remain with a persistent OSAHS after surgery compared to 15-37% of non-obese children (3).

The performance of the orthodontist after surgical removal, with the rapid expansion of the maxilla and even with intraoral appliances of mandibular advancement (11–14), depending on the skeletal deformity, allows an improvement in the respiratory picture, apparently reducing the AHI of cases of persistent OSAHS (2). However, studies of orthopedic/orthodontic therapy in the improvement of OSAHS

are still scarce (1). In any case, it is important to remember that 90% of facial growth discrepancies end up being established around 12 years of age, making the orthodontic and orthopedic approach paramount to intercept these deviations, regardless of the surgical indication or not. Often, a phono articulatory reeducation becomes necessary to restore the lost neuromuscular balance. This type of approach confers great results in patients with mild to moderate OSAHS (5).

It is emphasized, then, the need d the perception of the problem and d the use of the questionnaire as a practical frequent because it allows the orthodontist to monitor the improvement of OSAHS and not only the correction of the malocclusion. Thus, it would be interesting for these patients to be screened at the beginning and followed up later for OSAHS in a multidisciplinary approach, but with shared responsibility for the treatment.

7 OTHER OSAHS APPROACHES

Another approach is the use of positive upper airway pressure (PAP) or continuous positive pressure (CPAP) in cases of contraindication to surgical removal or persistence of OSAHS in the postoperative period. However, one should consider the possibility of adherence of the child to the treatment and the possibility of changes in the growth of the face, in addition to the constant need to control the pressure provided for each phase of the child's development (4).

Still, other non-invasive procedures are used in the impossibility of performing surgical removal or in mild to moderate cases, such as the use of corticosteroids. The use of leukotriene antagonist receptors in children with mild and moderate OSAHS has shown positive results in the improvement of OSAHS after 3 months of use (4). The drug approach plays an important role when allergic rhinitis is associated with OSAHS. However, obese children over 7 years of age do not respond well to this therapy (5).

8 FINAL CONSIDERATIONS

Every healthcare professional who interacts with children plays a key role in screening for OSAHS. The approach to this syndrome should be multidisciplinary, involving the pediatrician, the otorhinolaryngologist, the orthodontist, and the speech therapist. Knowing that the main etiological factor is obstruction by onsillar adenoid hypertrophy, its surgical removal is often indicated. However, it is important to evaluate the presence or absence of other comorbidities. The performance of the dentist, more specifically of the orthodontist, is directed to the skeletal changes found as a result of mouth breathing, such as maxillary atresia and mandibular retrusion. And it plays an important role, especially considering that it is not only about morphological correction but rather about the improvement of a much more complicated health picture with serious consequences. In addition, it is often the most viable alternative for treatment within the clinical and life context of certain patients. The referral to the speech therapist comes from the orthodontist and its importance in the treatment should be emphasized. It should not be forgotten that apnea

and hypopnea can have a central or mixed origin, so the ability to look beyond the anatomical obstruction allows the professional to act in a way that always seeks health and quality of life.

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