



Brazilian consensus of snoring and sleep apnea – aspects of interest for orthodontists

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Abstract

The objective of this article is to clarify the positions of the medical societies that have worked together to establish a consensus regarding the clinical and laboratory parameters involved in sleep-disordered breathing, particularly snoring and obstructive sleep apnea syndrome (OSAS). Orthodontists have gradually come to take part in multidisciplinary teams that act in the area of human sleep, but few know about the uniformity coordinated by the Brazilian Association of Sleep. Clinical and scientific studies from the field of dentistry (particularly orthodontics) also must observe and follow these diagnosis and treatment criteria established by the Brazilian medical community.

Keywords: Sleep apnea. Obstructive. Snoring. Polysomnography.

INTRODUCTION

Sleep disorders can be grouped and classified into diverse categories. Three classification schemes have been identified; currently, the International Classification of Sleep Disorders manual from the American Academy of Sleep Medicine, published in 2005 (ICSD-2, 2005),¹ is followed. Two other classifications preceded this manual, one from 1979² and one from 1990,³ and the latter was reviewed in 1997.⁴ Sleep disorders are classified into eight groups, with obstructive sleep apnea syndrome (OSAS) classified in group II as a

sleep-related respiratory disorder, next to central sleep apnea syndrome and the sleep-related hypoventilation/hypoxia syndromes.¹

Sleep-related respiratory disorders are prevalent but are not always adequately diagnosed or treated.^{5,6} OSAS is one of the clinical entities that are most commonly found in the population, and its consequences involve extreme sleepiness, risk of transit and industrial accidents, cognitive deficits and cardiovascular diseases.^{7,8,9}

In 2007, an initiative of the Brazilian Sleep Association, the Brazilian Neurology Academy, the

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Brazilian Otorhinolaryngology and Facial Cervical Surgery Association, the Brazilian Pediatric Society, the Brazilian Pulmonology and Phthisiology Society and the Brazilian Clinical Neurophysiology Society sought to standardize the diagnosis and treatment of OSAS in adults, children and adolescents in Brazil. The field of dentistry was represented by three research dentists from the area of sleep who were invited by the Brazilian Sleep Association.

Meetings between the members of these societies and medical literature studies have guided the recommendations of this consensus. The final document had the evidence levels I-V as its basis, detailed in Table 1.

The purpose of this article is to clarify the guidelines of the medical societies with regard to the diagnosis and therapeutic treatment of sleep-related respiratory disorders, delimiting the orthodontists' area of operation on the basis of medical consensus and evidence levels that have guided the established criteria.

SLEEP RESPIRATORY DISORDERS

Sleep-related respiratory disorders are classified as follows: central sleep apnea syndrome (CSAS), obstructive sleep apnea syndrome (OSAS), sleep-related hypoventilation/hypoxia syndromes, sleep-related hypoventilation/hy-

poxia syndromes due to medical conditions and other sleep-related respiratory disorders (Table 2). Some of these disorders, such as CSAS and hypoventilation syndromes, possess subtypes that are not the focus of this study; moreover, they are clinical entities that orthodontists do not treat. Thus, the primary emphasis is given to OSAS and to the respiratory disorders in which the orthodontist functions.

Primary snoring is defined according to the International Classification of Sleep Disorders (ICSD) as the presence of characteristic snoring noises during sleep in the absence of alterations in

STUDY DESIGN (EVIDENCE LEVELS)
Randomized study, well-developed design, with low alpha and beta errors (I)
Randomized study, with high alpha and beta errors (II)
Non-randomized study, with simultaneous controls (III)
Non-randomized study, with historical controls (IV)
Study of series of cases (V)

TABLE 1 - Alpha error: probability (generally established as ≥95%) that a significant finding does not result from chance. Beta error: probability (generally established of ≥80%) that a non-significant finding is the correct result of the study. The beta error is dependent on the sample size. Modified from Sackett¹⁰.

Central sleep apnea syndromes
Primary central sleep apnea
Central sleep apnea caused by Cheyne-Stokes standard respiration
Central sleep apnea caused by high-altitude periodic respiration
Central sleep apnea caused by non-Cheyne-Stokes medical conditions
Central sleep apnea caused by drug or other substance use
Primary sleep apnea of infancy (newborn)
Obstructive sleep apnea syndromes
Obstructive sleep apnea, adult
Obstructive sleep apnea, pediatric
Hypoventilation/hypoxemia related to sleep
Non-obstructive alveolar hypoventilation related to sleep, idiopathic
Congenital central alveolar hypoventilation syndrome
Sleep-related hypoventilation/hypoxemia syndromes caused by medical conditions
Sleep-related hypoventilation/hypoxemia caused by parenchyma and pulmonary vasculature diseases
Sleep-related hypoventilation/hypoxemia caused by obstruction of the lower airway
Sleep-related hypoventilation/hypoxemia caused by neuromuscular and thoracic cavity diseases
Other sleep-related respiratory disorders
Sleep apnea/sleep-related respiratory disorders, nonspecific

TABLE 2 - Classification of Sleep-related Respiratory Disorders.¹

oxyhemoglobin saturation, as assessed by average ventilation and electroencephalogram measurements.⁴ Snoring and the presence of apneas can be exacerbated after alcohol ingestion or weight gain.

Upper Airway Resistance Syndrome (UARS) is a condition where airflow limitations occur with increased resistance of the upper airway (UA); it is associated with micro-awakenings and can cause sleep fragmentation and excessive sleepiness. By definition, these alterations occur in the absence of apneas, hypopneas and/or significant oxyhemoglobin desaturation.¹¹ Increased UA resistance is evaluated by increased respiratory effort (measured precisely through esophageal pressure or indirectly through a nasal cannula pressure transducer). UARS is generally considered as an initial stage of OSAS, as the two syndromes have the same pathophysiological characteristics.

OSAS is a multifactorial illness and is not yet completely understood, as it is partially caused by anatomical alterations of the upper airway and the craniofacial skeleton associated with neuromuscular pharyngeal alterations. OSAS is characterized by recurrent upper airway obstruction events during sleep, which are associated with clinical signs and symptoms. The obstruction is continuously manifested, involving an awakening related to increased respiratory effort and a limitation, reduction (hypopnea) or complete cessation (apnea) of air flow in the presence of respiratory movements. The interruption of ventilation generally results in oxyhemoglobin desaturation and occasionally results in hypercapnia. These events frequently end in microarousals.¹²

CENTRAL SLEEP APNEA SYNDROME (CSAS)

CSAS is a sleep-related respiratory disorder in which respiratory effort is reduced or absent in an intermittent or cyclical form due to cardiac or central nervous system dysfunction.¹ It is not a clinical entity for which the orthodontist can intervene, but the orthodontist needs to understand

this disorder when establishing a differential diagnosis between various sleep disorders.

CSAS possesses six subtypes: primary central sleep apnea; central sleep apnea due to Cheyne-Stokes respiration; central sleep apnea due to high-altitude periodic respiration; central sleep apnea due to a non-Cheyne-Stokes medical condition; central sleep apnea due to drug or substance use and primary sleep apnea of infancy (newborn) (Table 2).

Sleep-related hypoventilation/hypoxia syndromes (which may or may not be caused by medical conditions) are included in a specific chapter of respiratory sleep disorders that are no less important but will only be mentioned briefly (Table 2). Their study requires a specific approach that will not be discussed here.

OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS)

OSAS occurs when there is an airway obstruction concomitant with continuous respiratory effort with inadequate ventilation. The adult and pediatric forms are identified separately, as they are diagnosed and treated differently. The description of OSAS in this text will be directed toward adult OSAS, which is more prevalent than pediatric OSAS.

ADULT OSAS

OSAS is characterized by repeated episodes of complete or partial airway obstruction during sleep. These events frequently result in reductions in blood oxygen saturation and associated arousals. These events must last at least 10 seconds and can occur in any stage of sleep; however, they are more common in the N1 (stage 1 of non-REM sleep), N2 (stage 2 of non-REM sleep) and R (REM sleep) stages than in the N3 (stage 3 of non-REM sleep or slow-wave sleep) stage. When they occur during REM sleep, they are generally longer and associated with more serious oxygen desaturation. The oxyhemoglobin saturation generally

returns to normal values after the resumption of normal respiration.¹³

The most common symptoms of OSAS are fatigue upon waking, the sensation of non-restful sleep (independent of sleep duration), daytime sleepiness and worsening of quality of life.¹³ Household members often report snoring, choking episodes or respiratory cessation as well as frequent movements that interrupt sleep.¹⁴

PREDISPOSING AND ASSOCIATED FACTORS

The predisposing factors for OSAS are obesity (mainly central), male gender, craniofacial abnormalities such as maxillomandibular hypoplasia, increased soft tissue and lymphoid tissue in the pharynx, nasal obstructions, endocrine abnormalities such as hypothyroidism, acromegaly and previous family history of OSAS. The associated factors are systemic arterial hypertension (SAH), pulmonary hypertension, sleep-related cardiac arrhythmias, nocturnal angina, gastroesophageal reflux, cognitive impairment, decreased quality of life and insomnia.¹²

GENERAL PHYSICAL EXAMINATION

As part of the general physical examination to assess OSAS, anthropometric variables (weight and height), neck circumference and arterial pressure are measured. Among these variables, those that have the greatest predictive value are neck circumference, body mass index and the presence of arterial hypertension.^{15,16}

CRANIOFACIAL EVALUATION OF THE UPPER AIRWAY

It is fundamental to evaluate the craniofacial morphology of each individual, thus detecting alterations in maxillary (hypoplasia) and mandibular (mandibular deficiency or retroposition) development (Fig 1). Obese patients with fat concentrated in the trunk commonly present with a short neck, widened cervical circumference, excess fat in the submental region and an inferiorly dislocated hyoid bone.^{17,18}

Severe sagittal malocclusions (example: Class II with mandibular involvement) that are vertical (open bite) or transversal (cross bite, presence of ogival palate and maxillary atresia) can be related to inadequate growth of the base maxillary and/or mandibular bones; thus, their skeletal involvement should be evaluated.

A disproportionate oral cavity anatomy, due to soft tissue (principally tongue volume) or hypodevelopment of the maxillomandibular bone structure, can be assessed by applying the Modified Mallampati Classification. The patient is placed in a seated position with maximum mouth opening and a relaxed tongue; the examiner then observes the dimension by which the oropharynx is exposed and classifies the results from I to IV, in accordance with the greatest or least visibility of the free edge of the soft palate relative to the tongue base (Fig 2). The size of the palatine tonsils must also be evaluated (Fig 3), including the aspect of the pillars that can be voluminous or average and the uvula and soft palate, which can contribute to



FIGURE 1 - Patient with severe OSAS. Craniofacial and cervical morphology demonstrating a Class II standard with mandibular bony base involvement, short neck, widened cervical circumference and excess fat in the submental region.

a reduction in the retropalatal space, particularly if they are thick and elongated.^{17,18} Both the examination verifying the proportion between the oral cavity soft tissues and the oropharynx (Mallampati classification) and the evaluation of the palatine tonsils are routinely and preferentially completed by an otolaryngologist, but they can also be completed by an orthodontist.

Nasopharyngolaryngoscopy and cephalometry exams are recommended for evaluation of the upper airway. The first is performed exclusively by a medical professional; it is the endoscopic evaluation of the upper airway (UA) and must be performed to identify obstructions that may contribute to OSAS pathophysiology or hinder adaptation to CPAP. Spatial relationships, including those of the soft palate and tongue base to the posterior pharyngeal wall and the anatomical structures of the pharynx, are evaluated with a flexible endoscope. In addition to anatomical features, one can evaluate the tendency of the soft tissue of the pharynx to collapse and sag by forced inspiration with occlusion of the mouth and nostrils, creating negative pressure inside the UA (Müller maneuver). However, detection of the point of UA collapse is very subjective and nonspecific, and the importance of the Müller maneuver in evaluating patients with OSAS has been questioned.¹⁹ Cephalometry may help to identify sites of pharyngeal obstruction as well as contributing

to an evaluation of the space posterior to the UA, the length of the soft palate, the hyoid bone position, and the verification of the growth pattern and spatial positioning of the maxilla and mandible. The

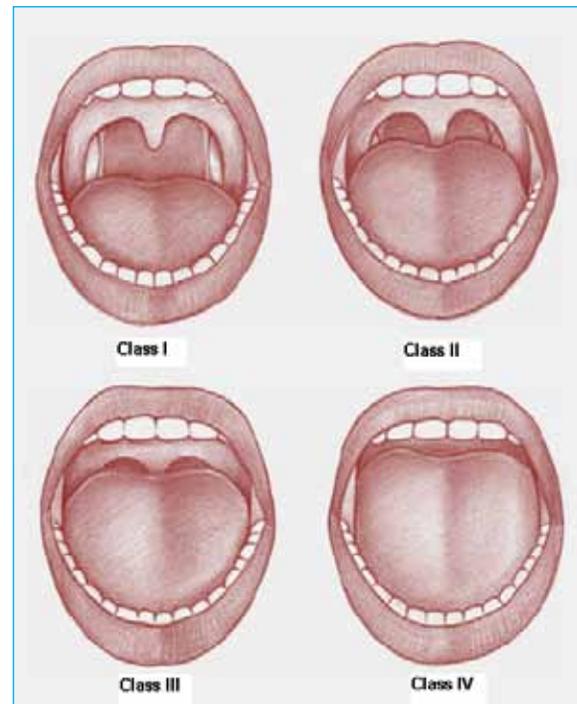


FIGURE 2 - Modified Mallampati Index: Class I, the entire posterior oropharynx wall is visible, including the inferior pole of the tonsils; Class II, part of the posterior oropharynx wall is visible; Class III, the uvular insertion and soft palate are visible (It is not possible to observe the posterior oropharynx wall); Class IV, only part of the soft palate and hard palate are visible.



FIGURE 3 - Graduation of palatine tonsils: Degree I, Palatine tonsils occupy up to 25% of the oropharyngeal space; Degree II, Palatine tonsils occupy between 25% and 50% of the oropharyngeal space; Degree III, Palatine tonsils occupy between 50% and 75% of the oropharyngeal space; Degree IV, Palatine tonsils occupy more than 75% of the oropharyngeal space.

present consensus stipulated that cephalometry should not be a routine test for evaluating patients with OSAS. This means that a cephalometric radiograph does not need to be requested. However, in cases of suspected craniofacial dysmorphism (abnormal craniofacial morphology), the preferred evaluation method is cephalometry.¹⁹ It should be noted that OSAS has a multifactorial etiology and that cephalometry is not capable of predicting the severity or presence of the disease. It is an important test in cases involving orthognathic surgery and to monitor possible changes in the position of dento-skeletal structures caused by intraoral appliances. Other imaging studies, such as CT and MRI, are also used as complementary methods in the visualization of airway structures in patients with sleep disorders.

DIAGNOSIS

The entire night polysomnographic study (PSG), carried out in the laboratory under the supervision of a qualified polysomnography technician, constitutes the standard diagnostic method for the evaluation of respiratory sleep disorders (evidence level I).²⁰ A record of at least 6 hours is recommended, with monitoring of the following parameters at minimum:

- Eletroencefalogram: electrodes F3, C3 and O1 and contralateral mastoid reference;
- Left and right electrooculograms;
- Electromyogram of the chin region;
- Electromyogram of the lower limbs (tibial anterior muscle bilaterally);
- Nasal and oral air flow recorded by thermistor or thermocouple type sensors;
- Record of nasal pressure obtained by pressure transducer;
- Record of thoracic and abdominal movement by means of piezo-electric and inductance belts;
- Eletrocardiogram;
- Digital oximetry;
- Record of snoring with tracheal microphone;
- Record of body position.

The principal diagnostic OSAS severity criteria are presented in Tables 3 and 4.^{1,12} The diagnosis of adult OSAS requires the presence of criteria A+B+D or C+D (Table 3):

TREATMENT WITH ORAL APPLIANCES

Oral appliances (OA) are an option with a high evidence level for the treatment of respiratory sleep disorders. Treatment with positive pressure airway devices and surgical treatment of soft pharyngeal and/or facial tissues are also part of the therapeutic arsenal for respiratory disorders that occur during sleep. These treatment modalities will not be described here, as orthodontists principally use oral appliances as therapeutic tools.

The parameters currently used in conducting treatment with OA are those suggested by the most recent studies, consensuses and task forces.²¹⁻²⁶ In the case that OA treatment is indicated, a medical referral is made in writing to the dentist. The dental treatment is composed of the medical history, physical examination, indication for treatment (or contraindication and return of the patient to the original doctor), fabrication and installation of the OA, return and maintenance of treatment,

Criteria (A+ B + D) or (C + D)
A) At least one complaint:
<ul style="list-style-type: none"> • Non-intentional sleep episodes during wakefulness, excessive daytime sleepiness (EDS), unrefreshing sleep, fatigue or insomnia • Waking with respiratory pauses, choking or asphyxia • Companion reports loud snoring and/or respiratory pauses in sleep
B) PSG: five or more detectable respiratory events (apneas and/or hypopneas and/or arousals related to respiratory effort)/sleep hour. Evidence of respiratory effort during all or part of each event.
C) PSG: 15 or more detectable respiratory events (apneas and/or hypopneas and/or arousals related to respiratory effort)/sleep hour. Evidence of respiratory effort during all or part of each event.
D) The disorder cannot be better explained by another sleep disorder, medical or neurological illness, medication use or disorder due to substance use.

TABLE 3 - OSAS diagnosis criteria.

Mild SAOS	<p>PSG: AHI greater than or equal to 5 and less than or equal to 15.</p> <p>» Daytime sleepiness or involuntary sleep episodes occurring during activities that require little attention, such as watching television, reading or riding in a vehicle as a passenger.</p> <p>» Symptoms produce discrete alterations in social or occupational functions.</p>
Moderate SAOS	<p>PSG: AHI is greater than 15 and less than or equal to 30.</p> <p>» Sleepiness or involuntary sleep episodes occur during activities that require some attention, such as attending social events.</p> <p>» Symptoms produce alterations in social or occupational functions.</p>
Severe SAOS	<p>PSG: AHI greater than 30.</p> <p>» Daytime sleepiness or involuntary sleep episodes occur during activities that require greater attention, such as eating, speaking, walking or driving.</p> <p>» Symptoms provoke marked alteration in social or occupational functions.</p>

TABLE 4 - OSAS Severity Criteria (PSG = polysomnography; AHI = apnea and hypopnea index).

monitoring and treatment of possible side effects, OA modifications and return to the original doctor to assess the treatment effectiveness. For cases in which the treatment was successful, long-term follow-up becomes essential.^{19,26}

Thus, the dentist performs the following roles:

- » Recognize a possible sleep disorder and/or associated risk factors, orient and appropriately recommend the patient, and direct the patient to a medical doctor;
- » Request a polysomnography, or forward to the doctor to do it whenever necessary;
- » Initiate and monitor the OA treatment as part of the joint consultation with the medical doctor;
- » Monitor and treat the potential side effects of OAs;
- » Complete the patient follow-up in long-term OA treatment;
- » Be involved in multidisciplinary teams in the surgical handling of patients with respiratory sleep disorders; especially when there is need for orthognathic surgery.
- » Work with children or adolescents in a preventive or intervening manner to promote

adequate bone growth to minimize the anatomical components of a future diagnosis of snoring and OSAS; in children already diagnosed with snoring or OSAS, the surgeon-dentist will carry out the indicated facial orthopedic-orthodontic treatments.

» Prerequisites

To establish the baseline condition, the presence and gravity of OSAS, its complications and the patients at risk must be assessed. This initial evaluation must be obtained by a medical doctor through a clinical consultation and polysomnographic examination. Having a medical indication for treatment with OA, the patient will be directed to a dentist. The dentist will verify if the patient possesses the adequate dental conditions for OA therapy.^{14,19,21-24,26}

» OA adaptation

Most adequate OA indications, fabrications and adaptations for each patient must be conducted by a dentist with training in the treatment of respiratory sleep disorders (evidence level I). This professional must be able to conduct the case, which means being able to evaluate the collateral complications and effects that these patients may display, including occlusion alterations, temporomandibular dysfunction and eventual damage to associated structures. It is important to note that attainment of the final OA therapeutic position constitutes a delicate balance between side effects and effectiveness.^{21,22,26}

» OA indications

• Primary:

Patients with primary snoring, UARS and mild-to-moderate OSAS (evidence level I).²¹⁻²⁴

• Secondary (evidence levels II and III):

Patients with moderate-to-severe OSAS:

1. Who did not accept CPAP;
2. Who are incapable of tolerating CPAP treatment;



FIGURE 4 - "BRD Appliance" (Brazilian Dental Appliance): mandibular repositioning appliance for the treatment of snoring and OSAS.²⁷



FIGURE 5 - "Tongue Retaining Device" (TRD).²⁸

3. Who failed to undergo CPAP or behavioral treatment;
4. Associated to surgical treatment.

Once the OA indication is confirmed, a choice must be made between the mandibular repositioning appliance (MRA) and the tongue retainer (TRA), which are the two currently available categories of OA (Figs 4 and 5). The gradual adjustment MRA presents scientific evidence for the treatment of snoring and OSAS, while the TRA only possess evidence for the treatment of snoring, especially in edentulous conditions.^{21-24,26}

» **Contraindications of OA (evidence levels II and III)**²¹⁻²⁴:

- Diagnosis of predominantly central sleep apnea;
- Active periodontal disease or accented bone loss;
- Severe temporomandibular dysfunction.

Objective of OA (evidence level I):

- Patients with primary snoring without OSAS or UARS: to reduce snoring to a subjectively acceptable level.
- Patients with OSAS: resolution of clinical signs and symptoms and AHI normalization, oxy-

hemoglobin saturation and sleep fragmentation.

Follow up (evidence level I)^{21-24,26}

It is important to clarify that OAs constitute a form of continuous treatment for an indefinite time.

Patients with primary snoring: clinical dental accompaniment is recommended, without the need for polysomnographic follow up.

Patients with UARS or OSAS (any severity): polysomnography with OA in the final position is indicated to assure a satisfactory therapeutic benefit.

- After final adjustments and evidence of effectiveness through polysomnography:

» Dental follow up: every six months in the first year and annually thereafter. The intention is to monitor the adhesion, to evaluate deterioration or misalignment of the OA, to evaluate the health of the oral structures and the integrity of the occlusion and to address the signs and symptoms of OSAS.

» Medical follow up: periodic clinical and polysomnographic reevaluation when the doctor judges it to be necessary.

CONCLUSIONS

The orthodontist who acts or intends to act in the field of sleep study needs to have fundamental knowledge of the adopted clinical-laboratory diagnostic parameters, the established definitions and the limits of their area of performance together with the multidisciplinary teams that accompany and treat sleep-related respiratory disorders.

The orthodontist may request polysomnog-

raphy when deemed necessary, being the definitive diagnosis of sleep disorders, their severity and evaluation of comorbidities, medical assignments, which are based on polysomnographic findings. The orthodontist is very important to identify sites of pharyngeal obstruction, in evaluating and treating orthopedic and/or surgical treatment of maxillomandibular disharmonies, as well as in therapy of OSA with oral appliances.

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