OSAS Treatment: Orthodontic-Ventilatory-Surgical Techniques

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Abstract

Obstructive sleep apnea is a chronic disorder characterized by repeated episodes of cessation of breathing and it is a symptom of anomalies ranging from the Upper Airways Resistance Syndrome (UARS) to Obstructive Sleep Apnea (OSA).

The syndrome of Obstructive Sleep Apnea (OSA) is characterized by a continuous, partial or complete, collapse of the upper airway during sleep that causes a blockage (obstructive apnea) or reduction (obstructive hypopnea) of the air passage. According to the latest data of the international literature, the prevalence of OSAS in the population is between 1% and 4%. Most of the respiratory pauses last from 10 to 30 seconds, but may persist for more than a minute with severe desaturation of O2 in the blood, resulting in oxyhemoglobin desaturation. OSAS is associated with a collapse of the upper airway at the pharynx level between the nasal choanae and epiglottis, and in the airway tract without rigid support. The patent is related to the dilator muscles of the pharynx, from muscle ioglossus and the genioglossus muscle. The tone of these muscles is increased during the inhalation. During obstructive apnea leads to the complete collapse of the walls with stop airflow, snoring ceases while persist thoracic movements that gradually increase in amplitude. Chemical changes in blood and pressure stimulate chemoreceptors and baroreceptors to send signals to the neural systems, responsible for the reactivation of the mechanisms of wakefulness: the tone of the pharyngeal muscles and muscle genioglossus recovered, and is restored patency of the flow which results in a normalization of the parameters.

Introduction

In the literature, Lavie (1) estimated the frequency of the OSAS syndrome among male subjects workers, around 1%. One of the more comprehensive studies about OSAS was conducted on the population of Wisconsin by examining 602 polysomnographic of men and women aged between 30 and 60 years: 2% of the female and 4% of the men had an apnea index greater than 5 episodes per hour with daytime sleepiness.

Bixler et al. (2) estimated an average prevalence of OSAS around 3.3% in male population aged between 20 and 100 years: the peak of 4.7% is in the range between 45 and 64 years.

From the analysis of the literature it is clear that studies conducted by different authors differ in terms of stratification of samples and diagnostic thresholds based on the index of apnea/hypopnea.

The pathophysiological mechanisms involved in the obstructive sleep apnea are complex and not fully understood.

However there are several factors predisposing distinguishable in general and specific. The most important risk factors were reported in Table 1.

Among the general factors that may predispose individuals to sleep apnea, the most important are:

- Sex and age: it was noted that in males the resistance of the pharynx increase with age, probably due to the increase in body weight.
- Obesity: fat deposits in the wall of the pharynx can lead to a narrowing of the lumen.
- The intake of substances such as ethanol and benzodiazepines: substances that reduce the activity of the hypoglossal nerve and electromyographic activity of the genioglossus).

Among the specific factors related to the inspiratory muscles and the ventilatory drive, the most important are:

- reduction of the caliber of the upper airway;
- presence of airway lumen reduced below the base of the tongue;
- long and large soft palate;
- inferior location of the hyoid bone;
- retrognathia;
- the length of the tongue and its dimensions;

There are also conditions that favor the pathology like the lingual back positioning and macroglossia that interfere with the effectiveness of the genioglossus muscle to support and correct the prolapse of the tongue on the pharynx.

The position of the hyoid bone has an important role in determining the development of OSAS since the muscles inserted on it are able to exert a soothing
effect on the pharyngeal wall and to oppose to collapse. Although more rare in adults than children the adenoid and tonsillar hypertrophy is one of the factors predisposing the occurrence of OSAS.

The skull-facial stenosis are often associated with OSAS but they are usually treated in childhood. Although the cause-effect relationship has to be proven yet; the obstruction of the upper airway during childhood appears to contribute to the development of craniofacial anomalies that cause the narrowing of the upper airway.

The identification and treatment of these disorders through the use of dentofacial orthopedic techniques can lead to benefits in children with OSAS.

To assess the severity of OSAS the Apnea /Hypopnea Index (AHI) is used; it indicates the number of episodes of apnea or hypopnea that occur within an hour of sleep. It is calculated using polysomnographic recordings, when the value is greater than 5 events per hour, in the presence of symptoms such as excessive daytime sleepiness, it is possible to diagnose OSAS.

The American Academy of Sleep Medicine (3) has established the following criteria to determine the severity of OSAS:

- AHI ranging between 5 and 15 episodes per hour: MILD OSAS (involuntary sleepiness during activities that require little attention).
- AHI ranging between 15 and 30 episodes per hour: MODERATE OSAS (involuntary sleepiness during activities that require some attention)
- AHI greater than 30 episodes per hour: SERIOUS OSAS (sleepiness during activities that require attention).

The index of respiratory disorder (RDI) is also used. It records the number of apneas and hypopneas per hour of sleep with a number between 5-10. An RDI greater than 5 is considered abnormal.

**Symptoms**

The most common symptoms associated to OSAS are:

- Snore
- Excessive Daytime Sleepiness
- Smothering Night
- Unrefreshing Sleep
- Low Sleep Quality
- Insomnia
- Morning Headaches
- Decreased Concentration
- Decreased Memory

- Nocturia
- Impotence
- Anxiety And Depression
- Esophageal Reflux

The snoring is present in 95% of patients and the apnea is a more specific symptom that occurs in respiratory pauses often referred by partners).

There are frequent cases in which are reported incidents of awakening during the night due to the feeling of suffocation.

Another very common symptom is daytime sleepiness due to sleep fragmentation took place during the night, it is definable by the Epworth Sleepiness Scale (4) that consists of a questionnaire to measure the propensity for sleep: score greater than 10 is sufficient to measure daytime sleepiness; if the score is greater than 16 this symptom is very severe.

Also difficulty awakening, irritability, depression and difficulty in concentration can be listed in the common symptoms associated with OSAS.

**Signs**

The signs representing the syndrome are:

- Obesity
- Increased Neck Circumference
- Retrognathism
- Reduction In The Growth Of The Maxilla
- Overjet
- Malocclusion
- Tonsillar Hypertrophy
- Macroglossia
- Narrowing Oropharyngeal
- Edema And Erythema Of The Soft Palate
- Nasal Obstruction
- Hypertension

The most important are:

- severe obesity is expressed with the Body Mass Index (BMI), calculated by dividing weight by the squared height
- craniofacial anatomy: it can influence predisposition to have trouble in breathing and obstructive apneas. Mandibular retrusion, growth defect of the maxilla, movement of the hyoid bone and skull base anomalies are the most common disorders seen in cephalometric of patients with OSAS.

**Diagnosis**

The diagnosis of the syndrome is unquestionably
attributed to clinical and polygraphic examinations that establish the definitive diagnosis.

The Cardiorespiratory Polysomnography (PSG) is the more specific test for the diagnosis and it is performed in a sleep laboratory by experts. It is based on continuous recording at night with a minimum of 12 measurement channels of sleep and breathing such as electroencephalogram, electrooculogram, electromyography, nasal air flow, oral air flow, oxygen saturation, body position and electrocardiogram. The examinations adjust the frequency of apneas (complete transfer of breathing for 10 seconds or more) and hypopneas (reduction in amplitude of the air flow or movement of the chest for 10 seconds or more with oxygen desaturation of at least 3%).

The diagnosis of OSAS can be based on examination of a single night, even though the results performed in a greater number of nights have to be taken into greater consideration.

**Treatment**

Therapeutic options in the treatment of Obstructive Sleep Apnea Syndrome are:

1. **Behavioral Therapies**

   Behavioral therapy is based on the elimination of predisposing factors such as obesity, reducing the intake of sedative and muscle relaxant, reducing smoking and alcohol, especially in the evening.

2. **Oral appliances**

   The therapy with oral appliances is an easy and non-invasive treatment for many patients. It includes a series of devices for mandibular advancement and to hinder the retroversion of the tongue during sleep, for patients with mild or moderate OSAS that had not benefits or do not tolerate ventilation therapy. These oral appliances help keep the obstructed airway open, determine an advancement of the tongue and the soft palate and jaw changing the muscular activity of genioglossus muscle.

   The appliances must be used permanently and must have full vertical occlusal coverage to prevent changes to the teeth.

   Mandibular repositioning appliances (MRAs, Mandibular Repositioning Appliances) move the jaw forward to improve breathing at the level of the upper airway and are the best type of oral devices. The first mechanism of action of an MRA is the movement of the tongue and the consequent increase in the anteroposterior size of the oropharynx. Nevertheless it is noticed that the cross-sectional area of the pharynx increases in size both laterally and anteroposterior, based on a different number of diagnostics imaging studies, including computed tomography, magnetic resonance imaging and nasopharyngeal; while in the oropharynx there is only a lateral changing during mandibular advancement. The changes of the routes structure produce variable results thanks to these devices from individual to individual, precisely for this reason the effect of the treatment is considered clinically weak.

   The lingual devices (TDR, Tongue Retaining Device) that reproduce a repositioning of the tongue more than an MRA are less common.

   The majority of patients treated with MRA shows a decrease in daytime sleepiness, snoring and the evaluation of the number of apnea is lower in both episodes of apnea and in those of hypopnea.

   The persistent snoring and daytime sleepiness during treatment with MRA indicates insufficient efficacy of therapy.

   The proven benefits from TDR have still few evidence and tend to be less effective than those obtained with the MRA.

   Recent studies have shown that the MRA produces a lowering of blood pressure to a similar level to that of the ventilation therapy.

   Side effects due to MRA are common, including excessive salivation and dry mouth, dental and cranio mandibular pain and unnatural perception of occlusion in the morning. In the long run the occlusal change become apparent. The overjet and overbite decrease and may appear a lateral open bite. Occlusal changes are likely erroneous in patients with normal occlusion, though patients may benefit distal occlusion of care. The presence of 8 to 10 teeth per arch, and a minimum capacity of protrusion of the mandible (5mm) are required to obtain good results. Initially it is recommended a mandibular advancement of about 5mm or 50-60% of the maximum protrusion, then others increases will follow in weekly or monthly as better tolerated by the patient. The final position of the jaw depends on the subject's ability to protrude the mandible, on the severity of OSAS and on the diagnosis of occlusal device type.

   The devices consist of a double-arched plates maxillary and mandibular combined in various ways that include connectors elastic or plastic, metal and tubular connectors, connectors hook, extensions of acrylic resin or magnets. This type of equipment are the best because they facilitate the mandibular adaptation over time. The Dental arch needs
more time to adapt and requires the support of a specialist.

The TDR has been suggested for patients with dental support insufficient to apply MRA.

3. Ventilation therapy (CPAP)

The ventilation therapy is performed by applying a positive pressure in the upper airways, called CPAP (Continuous Positive Airway Pressure), which acts by lifting the intraluminal pressure of the upper airway at levels higher than those of the transmural pressure that leads to the collapse airway. About 50% of patients in the United States and 25% of patients in Europe have poor compliance with ventilation therapy (15).

4. Surgery of the sites of obstruction

When the other three therapeutic techniques are not adequate or sufficient, the surgery is taken into account, especially for patients with malformed or skeletal deformities. The anatomy and pathophysiology of the syndrome should be investigated in order to succeed with surgery. The choice of technique is linked to the site of narrowing or collapse of the upper airway.

Various techniques of nasal surgery are indicated in case of increase of nasal resistances.

In case of retropalatal narrowing:

- Uvulopalatopharyngoplasty (UPPP) (16): often associated with tonsillectomy.

In case of retrolingual narrowing:

- the Lingual Suspension (SL) (17): surgical procedure by which the genioglossus muscle is suspended to the symphysis;
- The advancement of the genioglossus (AG): consists of the transposition of the genioglossus forward on the mandibular cortical internal;
- the Hyoid Suspension (SI) (18) to expand the space respiratory lower rear anteriorly and laterally;
- resection of the tongue with hyoid -epiglottis plastic with significant volume reduction of the base of the tongue (19);

Current studies (19-22) have shown that the maxillo-mandibular advancement (MMA) is the better surgical therapy in patients with skeletal deformities and it is often associated with an intervention of genioplasty. The purpose of this paper is to obtain a congruence of the dental-skeletal relationships and determine the repositioning of the tongue with a reduced risk of airway collapse and increase airspace back through the simultaneous tensioning of muscles suprahyoid, palatine and side of the pharynx.

The MMA in the treatment of OSAS should be conducted by relating to two additional considerations: maximum progress possible with a cosmetic facial acceptable as “roll forward” the tissues of the anterior wall of the pharynx placed on the jaw and the hyoid bone and increases oropharyngeal airspace with cure rates of 95% -100%.

Patients candidates to undergo to MMA are:

- patients already treated with ventilation therapy or oral appliances;
- patients with abnormal dental-facial deformities with severe malocclusion with mandibular skeletal Class II (S. Treacher Collins, DTJ ankylosis with micrognathia);
- failure of the palate and nasal surgery;
- AHI greater than 20;
- drowsiness index greater than 10;

From the cephalometric study of these patients is evident a maxilla and mandible retrusion, high upper and lower facial heights, a mandibular occlusal plane and steep, anterior open bite and tongue retro-retrused.

The literature (23) shares the view that the increase in PAS after MMA is greater than that offered by other surgical techniques with anteroinferior osteotomy of the mandible or lingual suspension. Li et al. (24) state that the MMA is contraindicated in patients without craniofacial anomalies especially not to cause protrusion of the upper jaw and the upper lip.

Conclusions

The interest in this syndrome is determined by the important correlations with various systemic diseases such as hypertension, acute myocardial infarction, cardiac arrhythmias, stroke, seizures, premature death, stroke, peripheral neuropathy, ischemic optic neuropathy. Moreover, the same refers the increased incidence of harmful events that affect patients during daily activities. The signs and symptoms of patients with OSAS are recognizable in the first instance that the orthodontist can document the size of the tongue and uvula, maxilla and mandible retrusion and all other abnormalities that may contribute to narrowing airways causing a choice of the most appropriate treatment for the patient.

References

1. Lavie P. Sleep apnea industrial workers In: Guilleninovet C, Lugaresi E., eds, Sleep/wake disorder: Natural Histoty Epidemiology and long


Illustrations

Illustration 1

Table 1: The most important risk factors for OSAS.

<table>
<thead>
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<th>Risk Factors for OSAS</th>
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<td><strong>Unmodifiable:</strong></td>
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<tr>
<td>• Aging</td>
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<td>• Gender Male</td>
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<td>• Menopause</td>
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<td>• Race</td>
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<td>• Genetic</td>
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<tr>
<td><strong>Partial Modifiable:</strong></td>
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<tr>
<td>• Obesity</td>
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<tr>
<td>• Fat Distribution Neck Or Bowels</td>
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<tr>
<td>• Craniofacial Anomalies</td>
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<tr>
<td>• Abnormalities Of The Soft Tissue And The Upper Airway</td>
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<td>• Alcohol Consumption</td>
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<tr>
<td><strong>Associated Conditions:</strong></td>
</tr>
<tr>
<td>• Hypothyroidism</td>
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<tr>
<td>• Down Syndrome</td>
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<td>• Acromegaly</td>
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