



## The orthodontist and obstructive Sleep Apnea - an orthodontic perspective

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### Article History:

Received on: 23 Oct 2020  
Revised on: 24 Nov 2020  
Accepted on: 30 Nov 2020

### Keywords:

cephalometric diagnosis of OSA,  
OSA,  
Orthodontic appliances in OSA,  
role of orthodontist

### ABSTRACT

Obstructive sleep apnea (OSA) is a recurrent respiratory condition related to sleep, characterised by sporadic narrowing and pharyngeal airway obstruction, with adverse effects on sleep efficiency and gaseous exchange. OSA is a poorly identified medical disorder where the diagnosis of undiagnosed patients involves a thorough history and concentrated physical assessment. The combination of anatomical and neuromuscular risk factors in the pathogenesis of OSA has resulted in a varied approach to its management. Individuals with OSA often feel unrested, fatigued, and sleepy during the daytime. These declines in daytime function can translate into higher rates of job-related and motor vehicle accidents. Screening to identify unrecognized OSA followed by appropriate treatment might improve sleep quality and normalize the AHI and oxygen saturation levels to prevent adverse health outcomes. The role of orthodontist in screening and cure is treasured in the multidisciplinary administration of OSA. The aim of this assessment is to summarize the recent information's on the unique contributors to OSA with a centre of attention on diagnostic strategies and various orthodontic appliances which may also be considered for the cure of OSA and designed to offer guidance to practising orthodontists on the suggested role of the speciality of orthodontics in the management of obstructive sleep apnea.



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ISSN: 0975-7538

DOI: <https://doi.org/10.26452/ijrps.v11i4.4105>

Production and Hosted by

IJRPS | <https://ijrps.com>

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### INTRODUCTION

Obstructive sleep apnea (OSA) is a respiratory condition with reduced or full airflow obstruction given the patient's continued breathing effort (Lowe,

2002). This normally happens during sleep, muscles are relaxed, and the gentle throat tissues collapse, leading to upper airway obstruction (Sanders and Kern, 1990) (Figure 1). Therefore, there are partial and absolute respiration delay, which last during sleep for a minimum of ten seconds. So, along with oxygen, saturation degree in blood also decreases rapidly and in extreme cases drop by 50 per cent or more. The brain responds when there is insufficient oxygen and warns the body that induces brief sleeping arousal. This reinstates natural breathing pattern. This pattern will take place thousands of times once every night. That results in fragmentation of sleep quality and produces extreme daytime sleepiness (Sia et al., 2017). Chronic persistent sleep is a typical symptom that prevails at some point of the lifetime and precipitated via interaction among a range of elements include muscle tone loss during

sleep, enlarged tonsils, massive tongue, retrognathic mandible, smoking, obesity, sedatives and allergic drugs. Snoring noise is a foremost indication that obstructive sleep apnea has come to be a clinical issue (Cistulli *et al.*, 2004).

### Classification

#### Aetiology

Anatomical factors that result in the narrowing of the pharynx are the main reason for OSA. These include skeletal anatomy such as micrognathia, retrognathia, inferior hyoid bone / constricted osseous airways and soft tissue such as macroglossia, large soft palate, tonsillary hypertrophy, fatty infiltration of pharyngeal tissue associated with obesity (Figure 2).

Neuromuscular factors in OSA reduce pharyngeal dilator muscle activity, increase pharyngeal airway compliance and actively inhibit muscle activity during REM sleep. These include alcohol, sedatives, and muscle relaxants.

#### Risk factors

Excess weight/ body mass index  $> 28 \text{ kg/m}^2$ . It is one of the greatest predisposing factors for OSA (Lin *et al.*, 2020).

Increased parapharyngeal fats deposition with neck circumference  $> 17''$  men and  $>16''$  ladies subsequently expand the collapsibility of the pharyngeal airway.

Conditions leading to obesity, like hypothyroidism and polycystic ovary syndrome, may additionally purpose OSA (Jonas *et al.*, 2017).

Reduced airway: Patients with inherit reduced airways or swollen tonsils or adenoids reduce upper airway.

Changes in a neural compensatory pathway that preserve airway patency decreased defensive reflexes that would otherwise amplify upper airway muscle activity to preserve airway patency.

1. Hypertension and Diabetes: Hypertensive sufferers are extra vulnerable to OSA.
2. Chronic nasal congestion: it happens more frequently in patients with constant nasal congestion at night.
3. Smoking: There is an extra probable risk to those people who smoke.
4. Sex: More commonly seen in men twice as likely as premenopausal women.
5. Higher hazard for those with a Family history of OSA.

6. Asthma sufferers are at excessive threat of creating OSA (Agrawal, 2016).

### Symptoms

1. Excessive daylight hours drowsiness
2. Stertor, found the incidence of obstructed respiration while sleep (Morsy *et al.*, 2019)
3. Sudden wake-up times combined with shortness of breath or coughing,
4. Waking up with xerostomia or raw throat
5. Morning headache
6. Trouble focusing whole day
7. Alterations in emotions like despair or moodiness, hypertension (Morsy *et al.*, 2019), perspiration at night and diminished libido.

### Diagnosis

#### Physical examination

1. During the initial visit to the clinic, weight and height are noted. Modifications to height and weight are reported at all visits. 50 percent of OSAHS patients have a BMI  $>30 \text{ kg/m}^2$ .
2. The diameter of the neck is recorded in OSAHS patients. The neck diameter is frequently raised by  $> 17$  (43 cm).
3. Visual inspection for backwardly placed mandible.
4. Evaluate the state of the nasal airway.
5. Obstruction of the higher airway is examined using oblique laryngoscopy, inaccessible sites.
6. Inspect the macroglossia tongue.
7. Examine dentition for the appearance of teeth or lack thereof.
8. Examine the pharynx for the measurement of tonsil, uvula appearance and lumen size.
9. Blood pressure assessment.
10. Conduct a respiratory, cardiovascular, neural test for diagnosing any conditions like cor pulmonale, chest wall deformity and myopathies.
11. It should be noted that hypothyroidism, acromegaly and thyroid function tests might be possible.

12. Polysomnography (Duce *et al.*, 2016): The gold widespread approach used to diagnose sleep-disordered respiration is a detailed in-laboratory PSG. Basic upper airway and respiratory physiology check can also be used for wakefulness.

## Tests and Scales for detecting OSA

### Apnea hypopnea index

The grading of apnea hypopnea is shown in Table 2.

### Respiratory disturbance index

Kapur *et al.* (2017) measures the mean amount of apneas and hypopneas per sleeping hours and arterial hemoglobin saturation during sleep (Sanders and Kern, 1990) shown in Table 3.

### Epworth sleepiness scale

Table 4 (Guimarães *et al.*, 2012).

### Oximetry

Because of the regular availability of inexpensive recording pulse oximeters, this test is regularly used as the first screening device for OSA. Extreme apnea is frequently associated with massive arterial desaturation, as simple and cheap pulse oximetry can be used as a screening tool for the extreme disease

### Multiple sleep latency tests (MSLT)

Measures the rate at which you fall asleep. This test is performed to determine the degree of sleepiness at some point of the day. A typical adult needs 10 or more minutes of daytime sleep, whilst it takes less than 5 minutes for the patient to fall asleep during the day. The MSLT may additionally be beneficial in accessing the immoderate level of daylight sleepiness and also in excluding other sorts of sleep disorders. MSLT included 4-5 doze with a duration of twenty minutes each 2 hours for the day. For each nap the period to sleep starts is averaged to determine the latency of the daytime sleep.

### Cephalometric

Separation of the lower jaw base from the hyoid bone where the ideal measurement was considered to be in the range of  $15.4 \pm 3$  mm.

The linear measurement between posterior nasal spine to the tip of the uvula that informs about the soft palate length have a standard range of  $34 \pm 6$  mm.

Width of the palate velum with a reference range of 6-10 mm and retroglossal space with the standard range of 10-16 mm, a higher value in these assessment shows a greater the likelihood of the patient developing OSA.

The cephalometric examination is normally done to upright patients and displays craniofacial features solely in 2D images. The importance of this method in OSA assessment is poor since the upper airway region modifications during breathing and reduces in lying flat on ones back position.

Other radiographic features usually found in OSA patients include Mandibular retrognathia, Retrognathic maxilla, Posterior vertical maxillary deficit, backwardly positioned tongue, increased mandibular plane angulation, Short chin angulation, reduced PAS, Poor gonial angles, Class II dental occlusion (but sometimes Class I), Steeper and shorter anterior cranial base, increased soft palate length (Yucel *et al.*, 2005).

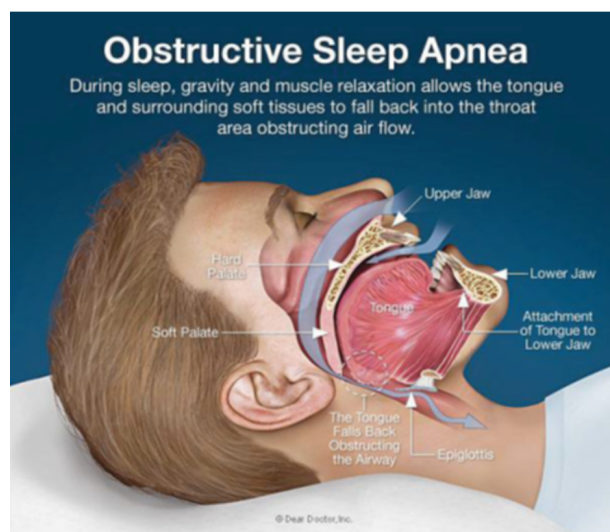


Figure 1: Throat obstructed during sleep due to relaxed muscle.

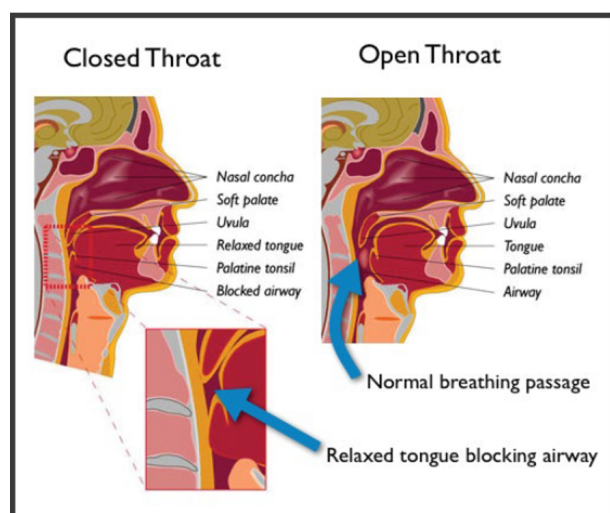


Figure 2: Open throat and closed throat.

### Cone-beam computed tomographic (CBCT)

Beneficial for diagnosis and morphometric examination of hard and soft tissue in regular orthodon-

**Table 1: Classification of apnea**

Apnea	Features
Obstructive apnea	Absence of airflow despite continuous ventilatory attempts.
Central apnea	Absence of airflow due to the lack of ventilatory attempts.
Mixed apnea	Contains both central and obstructive components, typically preceded by obstructive aspect with an initial central aspect.

Courtesy: (Sanders and Kern, 1990)

**Table 2: Severity of OSA based on AHI.**

Severity	Episodes hour
Mild	5-15 episodes/hour
Moderate	15-30 episodes/hour
Severe	> 30 episodes/hour

Courtesy: (Hh et al., 2020)

**Table 3: Respiratory disturbance index**

Index	No of episodes
Mild	1-10
Moderate	10-20
Severe	>20

Courtesy: (Sanders and Kern, 1990)

**Table 4: Epworth sleepiness scale.**

S.no	Severity	Range
1	Standard range	ESS<11
2	Mild sleepiness during the day	ESS =11
3	moderate sleepiness during the day	ESS =16
4	Severe sleepiness during the day	ESS >18

Courtesy: (Guimarães et al., 2012)

**Figure 3: Tongue retaining device.**

tic therapy, but with some hindrances with respect to OSA diagnosis (Behrents et al., 2019). CBCT does not give many details on neuromuscular tone, vul-

nerability to collapse or actual airway function (Hh et al., 2020).

#### Management of OSA

Can be classified as:

1. Behavioural Modification
2. Nonsurgical Modalities
3. Surgical Modalities

#### Behavioural modification

Measures include weight loss if obesity is a key factor in developing OSA (Aiello et al., 2016), reducing alcohol intake and sleeping pills, avoiding smoking. Research shows a ten percent reduction in body mass is related to a 26 percent drop in the index ranking of apnea-hypopnea (Neeraj, 2019). Positional treatment is helpful to deal with patients whose apnea is associated with physique positioning. There are a number of techniques that can ben-



efit patients who solely have slight breathing difficulty when they lie on their back. The tennis ball technique in which a socket stuffed with tennis balls can be sewn, length-wise down on their pyjama top or nightshirt. It will then be difficult to lie on their back so generally shift to their aspect, finding a comfortable slumbering position on.

## Nonsurgical Modalities

### Positive Pressure Therapy

This type of treatment has 3 types: Continuous positive airway pressure (CPAP), auto titration and bi-level positive airway pressure (Lowe, 2002).

CPAP is one most commonly used and considered as the gold standard technique for treating moderate to severe OSA that involves a steady flow of pressurized air through the nose or facial mask (Lowe, 2002). CPAP's fundamental mechanism is that it is delivered through a nasal or facial mask held round the head during sleep. The mask is attached to a tiny air compressor that pushes air under pressure, where it provides advantages pressure to the upper airways that prevent it from collapsing. Thus tissues during sleep are prevented from collapse, and apnea is effectively avoided without surgical intervention.

Expiratory positive airway pressure (EPAP): single-serving units that suitably sits on the nostrils to aid in maintaining the airway clear are less sized, less invasive when compared to CPAP machines, which will be beneficial to those with less severe OSA.

Bi-level positive airway pressure: Since the air pressure needed to avoid breathing blockage is usually lower on breathing out than on breathing in, this equipment is equipped to notice when the affected person is breathing in and out, also to lower current level of exhalation strain. This treatment, since it is costly, remains experimental.

Adaptive servo-ventilation devices (ASV) is utilized to treat central and obstructive sleep apnea. This equipment records the patient's usual respiratory pattern facts and immediately make use of airflow pressure to avoid breathing delays whilst you are asleep.

### Pharmacological agents

Various pharmacological agents that can be used to improve the obstructive sleep apnea include thyroid hormone supplementation, progestational agents-estrogen has been used in central apnea and weight problems hypoventilation syndrome, acetazolamide induces metabolic acidosis and central ventilation regulation control, very useful in periodic breathing and central sleep apnea. Central nervous system stimulants: include non- amphetamine, used for

fatigue treatment. Theophylline- proof to help its use in central sleep apnea. It also decreases obstructive events but allows sleep to be severely disturbed.

### Oral appliances

The most widely used alternative to CPAP therapy, designed to advance mandible forward, is becoming increasingly popular because it is quieter, compact and appears to be convenient. These appliances reduce the wakefulness and AHI scoring while shooting up the oxygen saturation in the blood.

Tongue Retaining Devices (TRD): (Lazard *et al.*, 2009) It was first developed in 1979 (Figure 3). It is a bubble-shaped, soft polyvinyl device. The patient's teeth rest in customized grooves sticks his tongue ahead into the bubble before suction is grasped, and the tongue is kept in place. Positioning the tongue ahead will take away any obstruction that is brought about by the root of the tongue.

### Uses of TRD

Found to be helpful in patients with macroglossia, bad oral hygiene, anodontia, and constant joint tenderness or whether breathing difficulty is worse when they lay on their back than on their facets.

### Oral Airway Dilator appliance

The Silencer System: it is an elastomeric plastic equipment accommodates the Halstrom Hinge Titanium Precision Attachment incisor stage, permitting consequent 2 mm advances of up to 8 mm, lateral 6 mm, bilateral 3 mm, and replacements of vertical pin heights. For the biting surfaces, a flat posterior bite plane is given. The patient can't adjust this appliance, however should be modified in the dental office.

Oral Klearway appliance: The appliance uses a maxillary orthodontic expansion appliance to push the lower jaw ahead sequentially. Klearway is a wholly customizable oral equipment used for the treatment of loud night breathing and mild to moderate OSA. Under the supervision of a dentist, tiny increments (25 mm) of ahead lower jaw development are done by the patient and made of thermoactive acrylic. Side to side along with up and down mandibular motion possible help the user to yawn, eat and intake liquid without dislocation.

The PM Positioner, connecting upper and lower splints with bilateral orthodontic expanders, is fitted with connectors on each side. This appliance consists of a thermoplastic material that needs to be heated every night in warm faucet water before it is inserted into the oral cavity. The adjustment hardware is tightly bonded to the oral side of the molar teeth and does not allow the lower jaw to move while

the device is in place.

**TAP-Thornton Adjustable Positioner:** The TAP-Thornton Adjustable Positioner enables the jaw to slowly shift 1/4 mm by means of anterior screw mechanism having a separate section for mandible and maxilla. The adjustment knob stands out and becomes noticeable during sleep through the lips. Each portion is inserted one at a time in the oral cavity, and then the affected person sticks out his/her chin before the hardware 'hook and bar' are attached.

**Modified Herbst:** This equipment design links upper and lower splints on each aspect with a piston-post and sleeve-adjustable telescopic mechanism. It prevents lateral movement but is quite convenient to open the jaws because the lower jaw is held using tiny orthodontic elastics. The device will break in people who grit their teeth during night time.

**The EMA Elastic Mandibular Advancement:** This equipment format uses specially built, proprietary elastic bands with significant freedom of motion in order to achieve the target position. It is the thinnest and smallest sizeable among all other appliances, also comparable to clear orthodontic acrylic retainers, and pushes jaw ahead in fairly widespread steps, and can be difficult to handle.

**Mandibular repositioning apparatus (Sharpley et al., 2014)** has shown to expand the lateral dimension of the upper airway, to enhance velopharyngeal block and also improve the diameter of the velopharynx, both in the lateral and anteroposterior dimensions (Cistulli et al., 2004). Sequential lower jaw advancement results in variable adaptive adjustments in the velopharyngeal and oropharyngeal regions, whereas static lower jaw advancement improves the upper airway calibre in most levels, and particularly in the oropharynx (Cistulli et al., 2004). Reduction in upper airway collapsibility was also shown with MRA.

#### **OPAP**

**'Oral Pressure Appliance:** a 'hybrid' therapy is combining a non-adjustable MRD and nCPAP; the air pressure is transmitted via a narrow pipe fitting on to the patient's mouth instead of a nasal nCPAP (Swope et al., 2017). Therefore, the patient can use the extra positive nCPAP barring the want for a nasal mask, bands round the head, or lying on the back.

**Sleep Apnea Implants:** One latest therapy for the treatment of apnea is the implementation of a pace-maker unit which activates the muscles to maintain the airways patent so that breathing becomes easy whilst sleeping.

#### **Surgical methods**

**Nasal, septal and adenoid surgery:** nasal ventilation can be impeded by Weak or malpositioned cartilage round the nostrils, as can droopy nasal tips or overly short nostrils. This can cause nasal respiration passage block if the septum has deviated. Septoplasty and adenoidectomy can help in a correction.

#### **Genioglossus tongue advancement**

The manner is performed in front of the anterior mandibular teeth through an incision below the gingiva. The tendons that connect the tongue to the jaw are pushed ahead on a tiny bone fragment creating a gap between the tongue and the throat, thus providing a wider airway. This is achieved with at least one other technique such as the UPPP or hyoid suspension.

#### **Maxillomandibular advancement**

A procedure in which Lefort I osteotomy of the maxilla and sagittal split advancement of the mandible (Vancan et al., 2019) is carried out. The idea is that when the bones are surgically advanced forward the soft tissues of the tongue and palate are also advanced, thereby widening the airway. The standard pass is around 1/2 an inch. This type of therapy is commonly undertaken if the obstructive respiration episodes have not been adequately improved by previous therapies and the patient has recurrent symptoms.

#### **Radiofrequency (rf) procedure or somnoplasty**

A surgical technique that makes use of radiofrequency heating to generate centred coagulative submucosal lesions resulting in lowering tissue quantity by piercing the tongue, throat or soft palate with a particular electrode attached to the radiofrequency generator. It heats the tissue to between 158 and 176 ° F.

There are no sources in the current document. The tissues on the inside part reduce in volume, while the outer side is left intact, which include taste buds.

#### **CONCLUSION**

Obstructive sleep apnea is one among the rarely diagnosed medical disorder, with many detrimental impacts on one's health and community as a whole. Both the medical profession and community as a whole will continue to combat this disease with increased understanding and help alleviate the associated harmful sequelae. Recently new technologies were introduced to identify OSA's key causes. Identification of OSA phenotypes may also be established to include a sense that patients are the greater possibility to experience strong con-

sequences for the disease. The quality of life for the patient and community can be improved with proper diagnosis and treatment planning.

#### Conflict of interest

The authors declare that they have no conflict of interest for this study.

#### Funding support

The authors declare that they have no funding support for this study.

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