



## OBSTRUCTIVE SLEEP APNEA AND ORAL HEALTH: A SHORT REVIEW

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### ABSTRACT

Obstructive sleep apnea is a potentially grave sleep disorder that results in breathing to repeatedly stop and start during sleep. There are several types of sleep apnea, but the most common is obstructive sleep apnea. Current literature gives an insight between Sleep disorders to oral diseases. With increased predilection in men OSA is a common disorder in the general population. It is also influenced by age and obesity. The purpose of this review update is to discuss in detail about the oral manifestations, diagnosis, treatment approaches and role of a dentist in the multidisciplinary approach of diagnosing and managing OSA.

#### Key words:

Obstructive sleep apnea; sleep disorder; oral health;

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## INTRODUCTION

Obstructive sleep apnea is a potentially grave sleep disorder that causes breathing to repeatedly stop and start during sleep. There are several types of sleep apnea, the most common being obstructive sleep apnea. Obstructive sleep apnea (OSA), is a chronic multifactorial respiratory disease. It consists of a temporary decline or cessation of breath for  $\geq 10$  seconds. It often leads to a reduction in oxygen saturation levels in blood of more than 3% to 4% and or neurological arousal. [1-3]

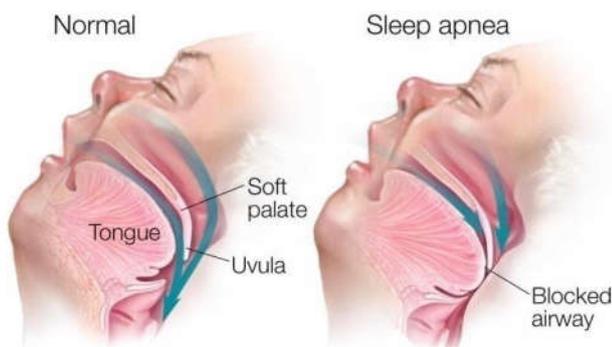


Figure 1 Normal airway and the blocked airway (Obstructive apnea)

OSA is the episodic closure of the upper airway during sleep by stoppage or reduction of airflow which causes intermittent hypoxia and fragmented sleep. This itself can be a risk factor

for many systemic diseases such as stroke, coronary heart disease, and Type II diabetes.

The etiology of obstructive sleep apnea has not been totally explicated but obesity has been studied as one of the contributory factors. Incidence of obesity has been allied with obstructive sleep apnea in 60%-90% of cases since the ancient investigations of the syndrome in the middle of the last century [4-6].

The inter-relationship between periodontal disease and systemic disease has been studied extensively with greater prevalence in patients with diabetes, cardiovascular disease, rheumatoid arthritis, and osteoporosis. [7-8]. Obstructive sleep apnea has the potential to cause systemic inflammation which has been proven by the markers of systemic inflammation found in patients who were diagnosed with sleep apnea [9]. This review provides an insight about the oral manifestations, diagnosis, treatment approaches and role of a dentist in diagnosing and treatment of OSA.

#### Prevalence of Obstructive Sleep Apnea

Sleep apnea affects a larger population, but it continues to be majorly unrecognized. Evidence suggests an increased risk of OSA in subjects (24% of men and 9% of women) with an average body mass index of 25 to 28 kg/m<sup>2</sup> belonging to the age group between 30 to 60 years old. [10]

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The prevalence of sleep apnea becomes alarming when considered in the context of the contemporaneous metabolic dysfunction epidemic (which is manifested in obesity, cardiovascular disease and type 2 diabetes in men). Evaluation of Type II diabetes has been made mandatory in patients diagnosed with OSA and vice versa as recommended by the International Diabetes Federation. [11]

### **Obstructive Sleep Apnea and the Oral Cavity**

Oral health is a reflection of systemic health. The manifestation of several systemic diseases emerges in the oral cavity and the same applies to obstructive sleep apnea as well.

Sleep disorders are shown to be linked to oral diseases in the literature. Obstructive sleep apnea is a common disorder in the general population with an increased predilection in men. It was also influenced by age and obesity [12]

Sleep disorders presents with the following oral manifestation which includes gingivitis, periodontitis, dry mouth, halitosis, frequent throat infections etc. A thorough examination and history is utmost important in the diagnosis.

The Mallampati's classification of soft palate and uvula was proposed to predict the chances of developing obstructive sleep apnea and thus using it as a guide to diagnose respiratory diseases as well as for pre anesthetic evaluation for patients undergoing procedures under general anesthesia and may require intubation.[15]

It is estimated that approximately 18 million Americans have sleep apnea according to the National Sleep Foundation. [15] OSA causes incessant breathing interruptions throughout the sleep with each break enduring from a few seconds to minutes and may occur 30 or more times per hour.

The mainstay therapy for OSA was introduced by Professor Colin Sullivan. He called it the Positive Air Pressure (PAP) therapy. Professor Colin Sullivan advocated for dentists, as part of a interdisciplinary team, to play a critical role in diagnosis and management of OSA in four areas:

1. Treatment of snoring and moderate OSA for adult subjects with oral devices to decelerate the progression of the disease.
2. Identifying at-risk children and adults by examining their upper airway on periodic visits.
3. Avoiding deleterious orthodontic treatments and treating pediatric patients with rapid maxillary expansion.
4. Anticipating the need for bimaxillary osteotomy in young adults requiring maxillofacial correction

### **Clinical Signs and Symptoms**

- Bruxism is said to be the first sign of sleep apnea. Attrition is a sign that a patient grinds his or her teeth. Wear facets on incisors can suggest that the patient positions the mandible anteriorly to open the airway.[15]
- Clenching can cause regressive alteration of the tooth structure and breakage as well as inflamed and receding gingiva and increase in number of carious tooth because the force damages teeth, making them susceptible to caries.
- The mobility of the anterior teeth due to trauma from occlusion may be in excess of that estimated on the

basis of the patient's health and the support available from periodontal structures.

- Progressive bone loss may be located or exaggerated in periodontitis-susceptible patients in sites of unusual wear or mobility.
- Tongue crenulations (i.e., scalloped borders) suggest that the patient is depressing the tongue forward against the mandibular teeth regularly to open the oral airway.
- Due to tongue positioning, development of an anterior or lateral open-bite relationship of the opposing teeth may result.
- Dimpling of the functional cusps and lingual or palatal surfaces of the dentition can indicate related gastroesophageal reflux disorder.

Other features include

- The development of orofacial pain
- A reduced jaw size
- Erythema in the larynx and/or pharynx (caused by snoring and mouth breathing a lot, which is another symptom of sleep apnea)

### **Obstructive Sleep Apnea and Periodontal Health**

Periodontitis is a chronic and infectious multifactorial that causes destruction of the investing tissues of the tooth due to the accumulation of bacterial biofilm [13]. Prevalance of the disease varies in different countries and and also has ethnic and racial prediliction with Africans and Hispanic being at greater risk.[13] Periodontal disease includes diverse periodontopathogens such as Porphyromonas gingivalis, Prevotella intermedia, Capnocytophaga, Bacteroides forsythus, Aggregatibacter actinomycetemcomitans, Fusobacterium nucleatum, Propionibacterium acnes, Staphylococcus epidermidis, and Pseudomonas aeruginosa.[13]

This microbiota sets of a local inflammation constituted by the infiltration of inflammatory cells such as polymorphonuclear cells, macrophages, lymphocytes, and plasma cells into the periodontal tissue which in turn liberates cytokines, interleukins, prostaglandins, and cell adhesion proteins.[14,15]

The bloodstream is infested with the pathogenic microorganisms affiliated with periodontal disease which elevates the levels of pro-inflammatory cytokines such as interleukin 1 (IL1) and tumor necrosis factor- $\alpha$  (TNF $\alpha$ ). This is similar to the major mechanisms associated with the correlation between periodontitis and systemic diseases such as cardiovascular disease, diabetes mellitus, and obstructive sleep apnea (OSA).[16]

The inter- relationship between periodontitis and OSA has not been explicated in literature. A statistically significant interlink between periodontal disease and OSA was found by Al-Jewair *et al.* in a systematic review and meta-analysis but the causal-effect relationship between the two diseases was disputable.[17] However, bidirectional association between both diseases have been proposed by numerous theories.

1. Oral respiration frequently leads to desiccation of the mucous membranes of the individuals with OSA (due to oral breathing or the pharmacological effects of hypotensive drugs), which enables the periodontal microbiota for greater colonization.
2. Both OSA and periodontitis are associated with the presence of systemic inflammation.
3. Both diseases are related with the oxidative stress

4. OSA shares common risk factors and comorbidities as that of periodontitis. [16, 18, 19]

### **Diagnosis of Obstructive Sleep Apnea**

A thorough history and clinical examination including overall health is the key to diagnosing oral disorders associated with systemic illness. A dentist can provisionally diagnose OSA with the comprehensive examination of the oral findings and correlating with the general health and patients history.

### **Nocturnal Symptoms of Obstructive Sleep Apnea**

#### **Snoring**

The primary symptom of OSA is snoring as it reflects the basic pathophysiology underlying the disorder, namely a critical narrowing of the upper airway [20]. It occurs in up to 95% of patients with a poor predictive value.[21,22] However, the absence of snoring makes OSA implausible and only 6% of patients with OSA did not report snoring in one report [23]

The symptoms of snoring and sleep apnea (i.e., cessation of breathing) extends from no sleep disturbance to excessive daytime sleepiness, the physiologic sequelae of recurrent asphyxia respectively. Over the years, there have been many dubious claims made regarding snoring cures. However, knowledge has greatly improved and much can be done to manage OSA and its associated consequences. It is in the provision of oral devices for OSA that a key role for suitably trained dentists is developing. Lack of a central drive to breathe could also result in obstructive sleep apnea.

#### **Witnessed Apneas**

One of the best diagnostic predictor of OSA is witnessed apneas, however they do not predict the severity of the disorder. [25,26]. Majority of the patients are referred to the sleep clinic due to concerns by the bed partner about witnessed pauses in breath during sleep.

#### **Nocturnal Choking or Gasping**

Patients with OSA often presents with nocturnal walking with a choking sensation, which can be quite alarming and presumably reflects an episode of outright wakening during an apnea episode. .

This choking almost invariably passes within a few seconds after waking up from sleep.

#### **Insomnia**

Another common complain the patients present with is insomnia and tiredness throughout the day, this is referred to as sleep maintenance insomnia. It implicates the disturbing effect on sleep of recurring arousal. However, most patients with OSA have little difficulty in initiating sleep.

#### **Other Nocturnal Symptoms**

Several other symptoms are reported by patients such as nocturia, enuresis, diaphoresis, frequent arousals, and impotence. A cause-effect relationship with OSAS is supported by evidences that these symptoms convalesce with continuous positive air pressure (CPAP) therapy [27]

#### **Daytime Symptoms**

##### **Excessive Daytime Sleepiness**

Although sleep apnea is the most common cause of excessive daytime sleepiness (EDS), it is ineffective in discriminating

between patients with and without the disorder and thus the reliability of this symptom as a definitive feature is questionable. The clinician must also differentiate EDS from other symptoms such as fatigue as patients frequently undermine the severity of daytime sleepiness [28]. This latter feature may reflect a genuine underestimation and/or a reluctance to admit the symptoms for social or work-related reasons.

Various questionnaires are available to assess the severity of EDS. The most widely used questionnaire is the Epworth Sleepiness Scale [29]. The history from the partner can be useful in scale. Objective tests are expensive and time consuming, but more reliable and have several advantages. These include the Multiple Sleep Latency Test (MSLT) [29], the maintenance of wakefulness test (MWT), [29] and the Osler Test, the latter being the simplest to perform.

#### **Other Daytime Symptoms**

Many other symptoms that are associated with sleep apnea are fatigue, personality changes, morning nausea, memory impairment, morning headaches, automatic behavior and depression. These features may be important in evaluating the impact of sleep apnea on a patient and the effectiveness of therapy, however no systematic review or meta-analysis have been performed or available in the medical literature on the capacity of these features to predict the presence or absence of OSA.

#### **Physical Characteristics/Examination**

##### **Obesity**

Statistical data reveals that around 30% of the world population is obese. Furthermore, obesity is a major risk factor for OSA. For instance, neck centimeters <37 cm is considered lower risk and circumference >48cm is considered as higher risk. [26] Lifestyle modification is hence an important factor to be considered in the management of OSA in obese patients.

##### **Craniofacial Anatomy**

Narrowing of the oropharyngeal airway with or without soft tissue deposition is the most common physical examination findings in patients with obstructive sleep apnea.[19] Retrognathia, micrognathia, tonsillar hypertrophy, macroglossia and inferior displacement of the hyoid are some other predisposing factors that could contribute to narrowing of the airway in patients with OSA. [19].

##### **Hypertension**

A direct relationship between OSA and blood pressure has been consistently established in the literature [ 30]. It is also suggested that the finding of increased blood pressure in patients can put them at an increased risk of developing the disorder. The probability of OSA appears to be particularly high in patients with drug-resistant hypertension.

#### **Criteria for Diagnosis of OSA**

The American Academy of Sleep Medicine (Westchester, IL) criteria for diagnosis of OSA considers the need for both objective and subjective scoring. There are three criterias to be fulfilled by a patient diagnosed/suspected to have OSA[31].

Criterion A or B, plus criterion C (to be fulfilled by the patient suspected of OSA).

- A: Excessive daytime sleepiness (EDS) that is not better explained by other factors
- B: Two or more of the following that are not better explained by other factors:
- Gaspings and/or choking in sleep
  - Repeated awakenings during sleep
  - Unrefreshing sleep
  - Daytime fatigue
  - Lack of concentration
- C: Sleep study i.e. Overnight monitoring reports five or more obstructed breathing episodes in an hour during the patients sleep. These events may include any combination of obstructive apneas/hypopneas or respiratory effort-related arousals, as defined below.

The severity of the disorder can be graded based on the frequency of unusual respiratory arrests in sleep.

- Mild: 5 to 15 events in 1 hour of sleep
- Moderate: 15 to 30 events in 1 hour of sleep
- Severe: > 30 events in 1 hour of sleep

#### **Treatment Approaches in Patients with Obstructive Sleep Apnea**

As precision medicine is gaining popularity, a customized diagnosis and treatment plan must be made for patients with oral diseases allied with sleep apnea. The treatment should include elimination of the etiology as well as stabilization of general health of the patient along with treatment for oral disorders.

As the risk of mortality and morbidity is significantly high in patients with obstructive sleep apnea, treating this should be given priority always before addressing any oral disorders. OSA could also be an incidental finding from the oral manifestation like other systemic diseases.

#### **Life Style Changes**

Diet counseling to reduce overweight is found to be supportive in patients with OSA associated with obesity. A less carbohydrate and fat diet with regular aerobic and cardio exercises is advocated.

Reduced sugar consumption may also be advantageous due to the link between cardiovascular diseases, OSA and diabetes.

#### **Positive Airway Pressure**

Positive airway pressure reduces the number of respiratory events that occur as one sleep, reduces daytime sleepiness and improves the quality of life.



Figure 2 CPAD Device, American Sleep Association

The most common type is called continuous positive airway pressure, or CPAP (SEE-pap). The pressure of the air breathed with positive air pressure is continuous, constant and somewhat greater than that of the surrounding air, which is just enough to keep the upper airway passages open.

CPAP basically works by splinting the upper airway pneumatically thereby preventing it from collapsing during sleep. CPAP is however not well-tolerated among the patients. Modifications to standard CPAP to increase acceptance have been met with disappointing results. Dry air in the machine can lead to problems such as sinusitis, laryngitis etc and hence humidification with heated tubing delivering heated moistened air was also introduced. However, this did not increase the compliance compared to standard CPAP [32].

CPAP was also compared with auto-adjusting CPAP (APAP), where respiration is monitored in a digital device and the minimum pressure of air is applied to maintain the upper airway open preventing it from collapsing. According to a systematic review and meta-analysis, APAP has very small effect on patient compliance [33]

#### **Oral Pressure Therapy**

The collapse of the upper airway happens at the retro palatal level. Oral Pressure Therapy device prevents this by applying gentle suction anteriorly and superiorly thus displacing the tongue and soft palate and making the breathing happen via nasopharyngeal airway. The advantage of OPT is that adherence is good; patients used the device on an average of 6 hours a night. Apart from oral tissue discomfort, dental discomfort and dry mouth, no other severe or serious adverse events were reported with OPT [34].

Oral appliances work in a similar fashion to that of OPT. They work in any of the three ways i.e. advancing the mandible, stabilize the tongue, lift the soft palate to increase the volumes of the upper airways to avert OSA or stabilize the tongue [35]. The Oral appliances, like the mandibular advancement device, have the advantage that it can be customized for each patient thus ensuring perfect fit and comfort. Oral appliances can however cause discomfort to the patient, it can be too uncomfortable or painful at times. There is still dispute on how exactly to titrate these OAs [36]



Figure 3 Oral appliance for sleep apnea, American Sleep Association

According to a recent meta-analysis with 17 studies, there were vigorous decreases in alpha hypopnea index (AHI) and in symptoms of sleepiness in OSA patients who used oral appliances in comparison with other groups. The other appliances used were mandibular advancement appliances; one study reported using a tongue-retaining appliance.

The authors concluded that there is sufficient evidence for oral appliances to be effective in patients with mild-to-moderate OSA [35]

### **Surgical Therapy**

In patients who cannot tolerate continuous positive airway pressure device or remains symptomatic despite compliance, surgical correction of the airway may be considered. Surgical interventions for OSA attempts to reduce the symptoms by improving the integrity of the upper airway and lessening the severity of airway obstruction. Surgical procedures performed to treat OSA yielded good clinical outcomes, in terms of reducing the symptoms as well as reducing the risk associated with the disorder such as cardiovascular risk and motor vehicle accidents, improving the quality of life, and reducing mortality. However, surgery is the first line of treatment only in children diagnosed with OSA and not considered curative in adult patients and is a last resort for adults with OSA.

The surgical procedures include nasal surgery, uvulopalatopharyngoplasty, mandibular advancement, palatal implants.

Candidates considered for surgical correction should be provided with information on the clinical success rates and potential complications associated with the procedure. [37]. The surgery should be planned and decided based on the patient's unique anatomy of the head and neck particularly the posterior pharynx and larynx.

Other factors to be considered include age of the patient, body mass index, systemic diseases or conditions etc. Surgical options may focus on correcting the anatomy of the nasopharynx, nasal cavity, hypopharynx and/or oropharynx, as well as completely bypassing the normal airway.

### **Dental Management- An Interdisciplinary Approach**

The role of dentist in managing obstructive sleep apnea and associated oral conditions include fabrication of oral appliances, maintenance of good oral hygiene and health and controlling any infection or inflammation of the oral cavity.

The primary treatment modality when OSA is being diagnosed is referral to an otolaryngologist. [25]

Majority of the cases are treated with an interdisciplinary approach and is highly dependent on the severity of the condition along with several other patient related factors.

As any other systemic disease, OSA also has several manifestations in the oral cavity as discussed earlier in this article. This disorder often presents with very minimal or no other systemic illness or symptoms other than fatigue and hence dentist have a significantly increased chance of diagnosing a case of Obstructive Sleep Apnea on a dental chair.

Referral to an ENT specialist or an otorhinolaryngologist or a pulmonologist is mandatory before being decisive about any mode of management. A thorough recording of the history will help us arrive at a more precise diagnosis and treatment plan.

A sleep medicine specialist can decide upon the treatment modality and there after the dentist can take a call on what choice of oral appliance or device would be ideal for the patient considering his intra oral anatomy.

A patient using an oral appliance should be periodically rechecked to assure the fit of the appliance, evaluation of oral hygiene and also to rule out the possibility of any extra forces the appliance could be imposing onto the dentition. This is of greater importance in children and adolescents where growth of the bones and the development of dentition could be affected by the prolonged use of these appliances.

Maintenance of records, motivation on oral hygiene, oral prophylaxis, controlling the dental infections to prevent them from being carried away into the lungs is recommended, followed by regular dental visits for the maintenance of devices.

### **CONCLUSION**

While considering treatment for patients with OSA, a step wise approach is used ranging from oral devices to decision for a surgery, lifestyle modification, psychological counseling etc. The role of a dentist in diagnosing and managing OSA is significant. A tailored treatment approach should be used in managing OSA patients. For all treatments being rendered by the dentist or the physician, the risks and benefits need to be weighed for each patient.

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