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Obstructive Sleep Apnea: A Prosthodontist's Viewpoint

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Abstract **Review Article**

Short sleep duration and poor quality of sleep, increasingly common in our modern society, have many adverse effects on general health. Obstructive sleep apnea (OSA) is a disorder in which a person frequently stops breathing during his or her sleep. The apnea-hypopnea index (AHI) is the average number of disordered breathing events per hour. OSA syndrome is defined as an AHI of 5 or greater with associated symptoms (e.g.: excessive daytime sleepiness, fatigue, or impaired cognition) or an AHI of 15 or greater, regardless of associated symptoms.

Keywords: Obstructive Sleep Apnea, Apnea, Hypopnea, Apnea hypoxia index, Prosthodontic management.

INTRODUCTION

Sleep is a sedentary state of mind characterized by altered consciousness, relatively inhibited sensory activity, reduced muscle activity and reduced interactions with surroundings and is a major buffer for hormonal release, glucose regulation and cardiovascular function [1]. Sleep disordered breathing (SDB) is an extremely common medical disorder, disrupts sleep pattern and quality. Short sleep duration and poor quality of sleep have many adverse effects on general health [2]. An apnea is a stop of inspiratory airflow lasting for 10s or more and hypopnea denotes the decrease in inspiratory airflow (by at least 30%) lasting 10s or more with an accompanying fall in oxygen saturation or sleep awakening. Sleep apnea is characterized by recurring incidents of apnea happening during sleep [3]. The prosthodontist role is getting significant in recent years in managing snoring and mild-to-moderate OSA [4]. OSA is more prevalent in males than females, and it increases with the age. The global prevalence varies from 0.3 % to 5.1% in general population. Among in Indian males varied from 4.4 % to 19.7% and in females it was between 2.5% to 7.4% from various studies [5, 6].

The acknowledgement of co-managing patients along with the sleep disordered breathing, by the prosthodontists are well justified ever since interest began in the research associated loss of teeth and severity of sleep apnea during 1990s and have been immensely influenced by the concomitant research data emerging in the field of sleep medicine.

CLASSIFICATION

Sleep apnea is of 3 types – [4]

- **Central sleep apnea (CSA) -** Both airflow and inspiratory efforts are absent due to the CNS disorder.
- **Obstructive sleep apnea (OSA) -** Despite the inspiratory efforts, the airflow falls out happen due to obstruction.
- **Mixed apnea -** Combination of CSA and OSA.

Each category can be further sub classified based upon Apnea hypoxia index (AHI) [7].

OSA is defined by the presence of at least 5 obstructive apneas, hypopneas, or both per hour while the patient is sleeping. AHI < 5 primary snoring.

OSA is commonly divided into 3 levels of severity:

(i) Mild AHI = ≥5 events /hr.
(ii) Moderate AHI = 15-30 events/hr.
(iii) Severe AHI = >30 events/ hr.

What is OSA?

Obstructive sleep apnea (OSA) is one such chronic condition of upper airway collapse during sleep characterized by repetitive episodes of cessation of respiration (apnea) or decrements in airflow (hypopnea), associated with sleep fragmentation, arousals and reductions in oxygen saturation [7] results from partial or complete obstruction of the upper airway during certain stages of REM & non REM sleep which occurs because of inadequate motor tone of the tongue and /or airway dilator muscles [8].

ETIOLOGY

Obesity is an important risk factor for obstructive sleep apnea (OSA) [9]. The predisposing factors for OSA include obesity, abnormalities in oropharyngeal or craniofacial region, alcohol, and smoking. The decrease in tone of dilator muscles, especially the genioglossus pushes the tongue posteriorly in the pharynx causes obstruction, is often the primary disposing factor in many individuals [10]. The obstruction can be divided into anatomical factors includes narrowing of lumen due to ageing, increased fat deposition and nonanatomical factors includes reduced sleep arousal threshold, ventilator control instability. CSA is caused due to momentary failure of respiratory centers in the medulla to stimulate inspiration due to hypercapnic, eucapnia, or hypocapnia [12].

Risk Factors for Obstructive Sleep Apnea – [9]

(a) **Age:** The increased prevalence of SDB in the elderly appears to peak after 65 years includes increased deposition of fat in the parapharyngeal area, lengthening of the soft palate, and changes in body structures surrounding the pharynx**.**

(b) **Sex:** A 4-fold higher prevalence of moderate OSA in postmenopausal women as compared with premenopausal women and interestingly, in postmenopausal women taking hormonal replacement therapy, the prevalence of OSA is similar to premenopausal women**.**

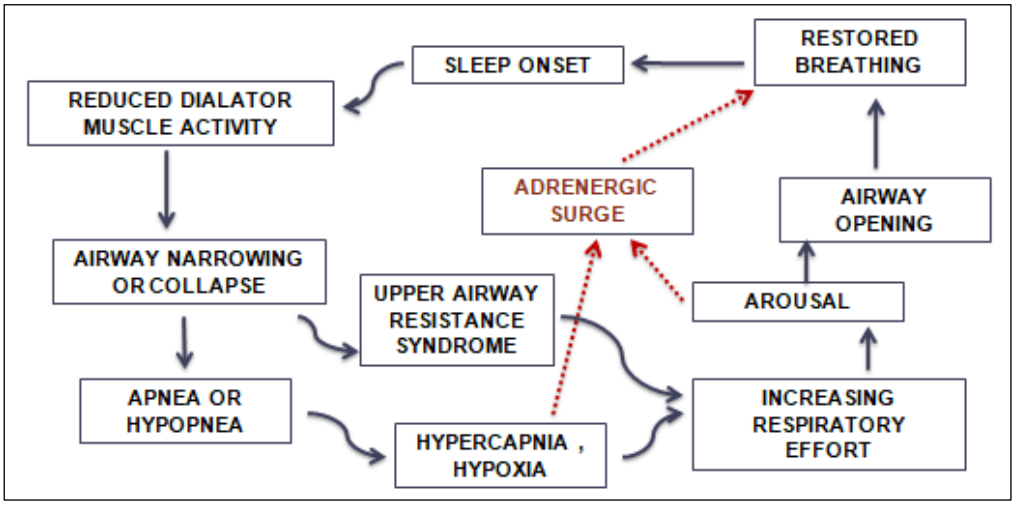
(c) **Influence of Tooth Loss:** Edentulism causes various anatomical changes which include decrease in vertical dimension of occlusion, Change in position of mandible, Change in position of hyoid bone, impaired function of oropharyngeal musculature such as loss of tone in soft palate and pharynx, macroglossia.

(d) **Smoking and Alcohol Consumption:** Smoking a cigarette induces airway inflammation and damage which could change the structural and functional properties of the upper airway, and increasing the risk of collapsibility during sleep. Alcohol relaxes upper airway dilator muscles, increases upper airway resistance, and may induce OSA in susceptible subjects.

PATHOPHYSIOLOGY OF OSA

Pathophysiologic mechanism of snoring and OSA can be explained by either the obstacle theory or the Bernoulli theory. According to the obstacle theory, an increased negative pressure during inspiration retracts the structures of the pharynx and makes them vibrate in the airflow to produce snore and possible obstruction in OSA [13] The Bernoulli theory (1738), assumes that the velocity of streaming air is higher and the pressure lower at a constriction of a tube compared with the larger part causes inward suction of the pharyngeal structures in a constricted area and snores by the vibration of wall structures [13].

OSA initiates - Oxyhemoglobin desaturation, CO_2 accumulation, In Sustained Situations Causes Various Systemic Issues and Other Life threatening Situations [14].



Symptoms of OSA – [6, 13]

Gasping for breath at night, Memory problems, Excessive day time sleepiness, Poor concentration, Night drooling of saliva, Depression, Irritability, Xerostomia, Poor work performance, Occupational accidents, Reduction in social interactions.

DIAGNOSIS [6]:

- **History -** Frequent Awakenings, Difficulty Falling Asleep, Unrefreshing Sleep, Daytime Sleepiness, Attention, Concentration, Memory Impairement, Mood Disturbances, Reduced Motivation & Energy, Morning Headaches, Excessive Nocturia.
- **Physical Examination** – Obese, Retrognathia, Micrognathia, Crowded airway, Enlarged tonsil, High arched palate, Nasal deformities.
- **Comorbid Conditions** – Resistant hypertension, Recurrent atrial fibrillation, Stroke, Myocardial infarction, Pulmonary hypertension, Chronic heart failure.

INVESTIGATIONS [15]:

At present, the "gold standard" for a definitive diagnosis of OSAHS is lab polysomnography. Pulse oximetry has been one of the most popular monitoring techniques used in attempts to record Oxyhemoglobin indices at screening for sleep apnea in the home.

(a) Polysomnogram (PSG) test involves overnight recording of sleep, breathing pattern, and oxygenation and analyses apnea, O_2 saturation, body position, change heart rate, snoring, desaturation relations, and sleep staging.
(b) Lateral cephalograms are used to analyse skeletal and soft tissue features of OSA patients.
(c) Computed tomography scanning significantly improves soft tissue contrast and allows precise & 3D reconstruction and volumetric assessment.
(d) Magnetic resonance imaging shows excellent soft tissue contrast, 3D assessments of tissue structures, and lack of ionizing radiation.
(e) Acoustic reflection test can be used to determine the airway obstruction and corresponding effect of mandibular advancement and protrusion on the upper airway.
(f) Spirometry is a pulmonary function test of studying pulmonary ventilation by recording movements of air into and out of lungs.

TREATMENT

Sleep-disordered breathing treatment can be divided into four general categories which include:

(1) Lifestyle modification i.e. weight loss, sleep position training.
(2) Continuous positive airway pressure.
(3) Oral appliances.
(4) Upper airway surgery [13].

Most patients with sleep apnea are being offered nasal continuous positive airway pressure as the treatment of choice. Oral appliances constitute an attractive non-invasive alternative for patients with sleep apnea, provided the efficacy, compliance, long-term tolerance, and satisfaction with these appliances are established [6].

Originally there are three concepts for a dental appliance to modify the airway, which could be used alone or in combination depending on where the airway obstruction occurs:

(a) Soft palate lifting – The prosthesis lifts and/or stabilizes the soft palate, preventing vibration during sleep.
(b) Tongue retention – Tongue-retaining devices (TRDs) incorporate an anterior hollow bulb, which generates a negative pressure vacuum when the tongue is inserted & held forward, opening up the airway.
(c) Mandibular repositioning (MRAs) hold the mandible in an antero inferior position, which, as a consequence of muscle attachment, indirectly brings the tongue forward, opening up the posterior airway [6].

Effects of complete denture wear with & without increased vertical dimension on OSA - Pivetti *et al.*, (1999), reported that edentulism may dramatically worsen severity of obstructive sleep apnea (OSA) and advised edentulous patients to wear dentures while sleeping [17]. Erovigni *et al*., (2005), demonstrated that wearing denture induces modifications in the position of the tongue, mandible and pharyngeal airway space which can favour the reduction of apnea episodes [18]. Bucca *et al.,* (2006), concluded that edentulism might worsen obstructive sleep apnea, particularly in subjects with no respiratory disturbances sleeping with dentures. Edentulism might act by modifying anatomy and function of the pharyngeal airway and tongue and favoring inflammatory edema. They suggested that the advantage of removing dentures during sleep should be weighed against the risk of favouring upper airway collapse [19]. Morelli *et al.,* (2011), collected magnetic resonance imaging (MRI) and polysomnography on 585 patients and concluded that there were no significant differences in AHI/ODI and total tongue volume between age, gender, and BMI matched apneics with and without teeth. However, there was a shape change in the tongue of edentulous apneics with a wider and shorter tongue than apneics with teeth [20].

The disadvantages of wearing dentures during sleep are:

Chronic inflammatory changes occur which causes irritation and alveolar bone resorption in the denture-supporting area, increasing the vertical dimension of occlusion causes strain on TMJ.

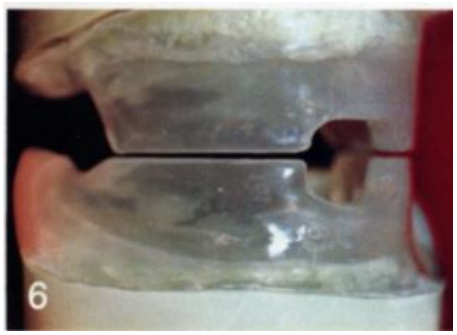
Oral Appliance Therapy In Complete And Partially Edentulous OSA Patients - Oral appliance therapy has emerged as a conservative, non-invasive treatment option for patients with OSA , mainly dwells on mandibular advancement with or without increasing the vertical dimension and retaining tongue from falling back.

Types of oral appliances for OSA

(a) Mucosa supported.
(b) Implant supported.

(a) Mucosa supported oral appliances for completely edentulous patients –

Meyer & Knudson (1990), were the first to report a clinical and laboratory technique for fabrication of a prosthesis which prevented sleep apnea in edentulous patient. Their technique involved positioning the edentulous mandible anterior to physiologic rest position using a heat-cured acrylic monobloc prosthesis with an orifice at front. They concluded that the prosthesis would be effective only if the suspected site of the obstruction is at the level of the base of the tongue and the posterior pharyngeal wall [21].



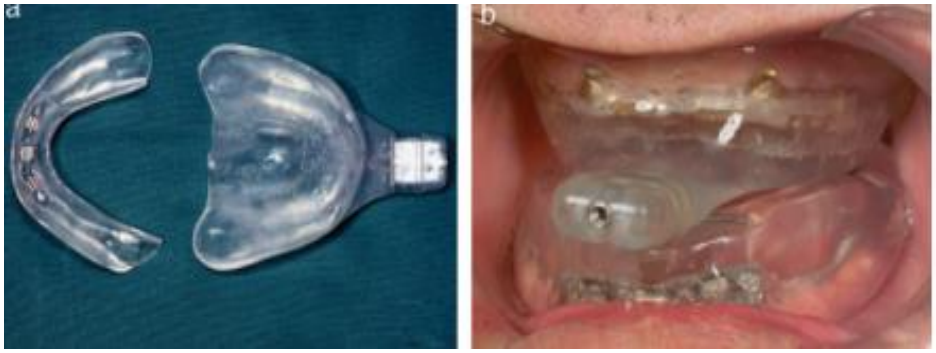
Kurtulmus & Cotert (2009), described a clinical and laboratory method for producing a new non-adjustable, acrylic monobloc functional splint combining a tissue borne mandibular advancement splint (MAS) and a tongue retaining device with custom-made tongue-tip housing for an edentulous patient with obstructive sleep apnea [2].

Piskin *et al.,* (2010), reported a fabrication method and treatment efficacy of an acrylic, monobloc, modified mandibular advancement device (MAD), which acts by displacing bulky masseter muscles laterally, to provide more space for tongue on totally edentulous patient with severe OSA [23].

(b) Implant supported oral appliances for completely edentulous patients –

Hoekema *et al.,* (2007), described an implant retained two piece mandibular repositioner appliance (MRA) as a viable treatment modality of edentulous obstructive sleep apnea hypopnea syndrome (OSAHS) patients. Patients were instructed to wear the MRA instead of their dentures whenever they slept. For patients requiring an implant retained MRA in the maxilla, two implants can be placed in the canine regions, as placing implants in maxillary posterior

region involves more morbidity and prolonged treatment protocol [24].



Flanagan (2009), reported on snore reduction appliance that can be constructed for the atrophic mandibular edentulous patient by using two endosseous implants to retain a complete mandibular denture and, in turn, an overlying bimaxillary removable snore reduction appliance [25].

Oral Appliances in Partially Edentulous Patients –

Ogawa *et al.*, (2009), reported a study on fabrication of a monobloc oral appliance with a denture base as a promising tool for the treatment of OSAS patients with multiple missing teeth and by utilizing 70% of the maximum protrusion of the mandible. He suggested not only absence of posterior teeth but also the removal of dentures during the night, as recommended by many dentists, was found to lead to a decrease in the retroglossal space, thus aggravating the symptoms [26].

Giannasi *et al.*, (2010), reported that oral appliances PM Positioner are an alternative for treating obstructive sleep apnea in partly edentulous patients. An adjustable mandibular repositioning appliance fitted to a few maxillary and mandible teeth proved effective in reducing the AHI and snoring, and increasing the SaO2 nadir and REM sleep during sleep [27].

CONCLUSION

Although the role played by the prosthodontists is still in its infancy, there is much to learn and understand in the rapidly evolving field of sleep medicine. Oral appliances play a major role in the non-surgical management of OSA and have become the first line of treatment in almost all patients suffering from OSA. Further research by prosthodontists involving advanced imaging and sleep studies will aid in tailoring the appropriate therapy & increasing awareness regarding OSA.

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