

Recent advances in the management of obstructive sleep apnea: The dental perspective

Prabhat K. C.,
Lata Goyal¹,
Afshan Bey¹,
Sandhya Maheshwari

Departments of Orthodontics and Dental Anatomy, ¹Periodontics and Community Dentistry, Dr. Z. A. Dental College, Aligarh Muslim University, Aligarh, Uttar Pradesh, India

Address for correspondence:

Dr. Lata Goyal, Department of Periodontics and Community Dentistry, Dr. Z. A. Dental College, Aligarh Muslim University, Aligarh, Uttar Pradesh, India. E-mail: latagoyal83@gmail.com

Abstract

Obstructive sleep apnea (OSA) is common in adult population. OSA shows detrimental effects on health, neuropsychological development, quality-of-life, and economic potential and now it is recognized as a public health problem. Despite the availability of expanded therapeutic options, polysomnography and nasal continuous positive airway pressure (CPAP) are the gold standards for the diagnosis and treatment for OSA. Recently, American Academy of Sleep Medicine has recommended oral appliances for OSA. Hence the therapeutic interventions that are directed at the site of airway obstruction in the maxillofacial region are within the scope of dentistry. Treatment of OSA can improve vitality, social and daytime functioning, family life and mental health of a person and hence the quality-of-life. Obesity is the main predisposing factor for OSA. Other than obesity, craniofacial abnormalities such as micrognathia and retrognathia, age, ethnic background and genetic predisposition, consumption of alcohol, smoking, and sedatives may also predispose to OSA. Treatment modalities for OSA are behavior modification, diet and medication, CPAP devices, surgical (maxillo-mandibular advancement surgery), and oral appliances. Treatment of a patient with OSA not only improves the physical health of the patients but also the mental and social well-being.

Key words: Obstructive sleep apnea, polysomnography, quality-of-life, Watch-PAT 200

INTRODUCTION

Apnea is a Greek word for “without breath”. Obstructive sleep apnea (OSA) was first described by Charles Dickens as Pickwickian syndrome in 1837.^[1] It was only in 1956 that Sidney Burwell carefully documented a case of an OSA patient, rationalized the signs and symptoms, and made a distinction between this disease and other illness.^[2] Since then there is a plethora of information on it and now it is recognized as a separate entity. Apnea^[3] is defined as a cessation of airflow during the sleep, which last for at least 10 s with oxygen desaturation of more than 3% and/or associated with arousal. It is classified as

central, obstructive, and mixed and can be graded as mild, moderate, and severe. In central sleep apnea, the respiratory muscles make no attempt to breathe as a result of central nervous system disorders. OSA refers to occurrence of at least five apneas or hypo apneas per hour, resulting in sleep fragmentation and decreased oxygen saturation.^[3] OSA is a common sleep disorder that can be potentially fatal. This serious disease condition greatly diminishes the quality-of-life in affected individual and impacts their state of health unfavorably. This review article is aimed to provide an overview of the role of dental professionals, particularly orthodontists and surgeons in the management of OSA. Treatment of a patient with OSA not only improves the physical health of the patients, but also the mental and social well-being.

PREVALENCE

The prevalence of the disease has been found to be 8% in men and 2% in women in the United States.^[4] Prevalence studies in western countries estimated 4% of middle-aged

Access this article online	
Quick Response Code:	Website: www.jnsbm.org
	DOI: 10.4103/0976-9668.101877

men and 2% of middle-aged women in general population.^[5] The estimated prevalence of sleep disordered breathing (SDB) in urban Indian men^[6] was 19.5% [apnea hypoapnea index (AHI) > 5] and 7.5% (SDB with hypersomnolence), which is striking and has major public health implications in developing countries like India.

Symptoms

The symptoms are: (1) loud snoring^[7,8] (all cases of OSA elicit snoring, but all snoring cases need not have OSA), (2) hypersomnolence^[9,10] (hallmark of OSA), (3) feeling of choking, (4) restless and unrefreshing sleep, (5) change in personality, and (6) nocturia.

RISK FACTORS

Obesity is the main predisposing factor for OSA.^[11] Obese patients with increased neck circumference (collar size greater than 16–17 inches) or those with the high body mass index (BMI \geq 25) who sleep in the supine position are potential candidates for OSA. When an obese patient falls asleep in the supine position, the muscles relaxation causes the base of the tongue to approach the posterior wall of the pharynx. With the consequent reduced air flow, the patient must increase the speed of the airflow to maintain the required oxygen supply to the lung. This increase in the airflow velocity causes vibrations of the soft tissue, which produced snoring. In non-obese patients, craniofacial abnormality like micrognathia and retrognathia^[12,13] may also predispose to OSA. Other conditions that may predispose to OSA include enlarged palatine tonsils and uvula, high arched palate, longer anterior facial height,^[14] shorter anterior cranial base,^[15] inferiorly displaced hyoid bone,^[16] disproportionately large tongue and long soft palate,^[17] and decreased posterior airway space.^[18] In addition to the obesity age,^[19] ethnic background and genetic predisposition,^[20,21] consumption of alcohol,^[22] smoking,^[23] and sedatives may aggravate the existing OSA. Alcohol and sedatives relax the airway muscles making more prone to obstruction.

Diagnosis of the OSA patients is based upon:

- *History of clinical signs and symptoms:* Examination of facies, oropharynx. Upper airway evaluation can be done with endoscopy/laryngoscopy, pharyngometry, and radiographic evaluation^[24-26] [computed tomography (CT) or magnetic resonance imaging (MRI)].
- *Home monitoring:* Unattended home studies in children with OSA have been improving in quality. In one study using a comprehensive methodology including cardio respiratory and 8 h of video recording, results obtained were very similar to those obtained by PSG in the

laboratory.^[27]

- *Laboratory sleep study:* “Polysomnogram.”^[28]
- Watch-PAT 200 (Great Lakes Orthodontics, USA. Item no 256-001).

POLYSOMNOGRAPHY

Polysomnography (PSG) is the gold standard^[29,30] in the diagnosis of OSA. It involves the overnight recording of sleep breathing patterns and oxygen saturation. Sleep staging includes electrocardiogram (ECG), electroencephalogram (EEG), and electromyogram (EMG). Normally the blood oxygen level should be above 90%, with obstructions, we can have varying degrees of desaturation. PSG provides AHI score, which is an estimation of apnoeic–hypoapnoeic episode per hour of sleep. In an adult patient, an AHI of 5 (or sometimes 10) generally indicates mild OSA.

WATCH-PAT 200 (GREAT LAKES ORTHODONTICS, ITEM NO. 256-001)

Watch-PAT 200 [Figure 1] provides comprehensive evidence of sleep architecture and we can use in dental practice.

Information provided by WATCH PAT 200

They are RDI and AHI, sleep time, ODI (oxygen level), sleep stages and architecture, heart rate, REM/Non-REM sleep, body position, and snoring intensity (dB).

Advantages for physicians/dentists

They are best-day evaluation, convenient for your patients, fast, efficient information download, reduced screening time, quicker outcomes.

Advantages for patients

It allows patients to sleep in the comfort of their own bed and simple and easy to wear.



Figure 1: Watch PAT 200

TREATMENT MODALITIES

Treatment modalities of OSA are aimed to increase the life expectancy, decrease the disease problems, and improve the quality-of-life. Less invasive treatment options should be selected whenever possible. These include: behavior modification, diet and medication, continuous positive airway pressure (CPAP) devices, surgical options, and oral appliances.

Behavior modification

Behavior modification includes changing the sleep position from the supine to the side position by the use of pillow/ tennis ball, avoidance of alcohol, and sedatives for 3 h before the sleep, and body weight control.

Diet and medication

For obese children, weight loss and maintaining a healthy diet might prove to be the ultimate treatment for their OSA.^[31] Antibiotic medication,^[32] topical intranasal application of corticosteroids,^[33] leukotriene receptor antagonist,^[34] and anti-inflammatory therapy^[35] can be used for mild or residual OSA after surgery.

Continuous positive airway pressure device

Continuous positive airway pressure device (CPAP)^[36] is the noninvasive gold standard treatment for patients with moderate-to-severe OSA. It acts by continuously pumping the room air under pressure through a sealed face mask or nose mask into upper airway or lung. Although CPAP is most efficacious treatment option, it requires use of mask interface, sealed tubing, and a device connected power sources. This complexity limits its acceptance by patients and leads to suboptimal treatment adherence.

Surgery

Rojewski *et al.*, in 1984, estimated that 1.5% of patients with OSA have space-occupying lesions. In such cases, surgical extirpation is potentially corrective. Kuo *et al.*^[37] initiated the use of orthognathic surgery for the treatment of OSA in 1979. Hard tissue surgery for the OSA includes genioglossus advancement (GGA) and maxillomandibular advancement (MMA) with overall success rates of 96% to 100%.^[38,39]

The amelioration of OSA by MMA surgery can be predicted by analyzing anatomical airway changes with the three-dimensional (3-D) geometrical reconstruction and computational fluid dynamics.^[40] Computer enabling technology lab (ETLab) and computational simulation lab (CSLab) can be used to analyze anatomical airway changes for previously operated patients with a clinical cure of OSA. MMA surgery reduces airway resistance and pressure effort (gradient) of OSA by increasing the dimension of airway.

ETLab has been used to reconstruct the upper airway as a 3-D computer model (bone and soft tissue surrounding the pharyngeal airway) from the existing computed helical tomography scan format of OSA patients. ETLab can compare and construct the geometry with numerical meshes of the airway between pre- and postoperative MMA by the use of bioengineering software. This technology used high fidelity computation fluid dynamics simulations, developed by CSLab, for prediction and analysis of flow field in airway for pre- and postoperative MMA. It is possible to use the simulation to predict the likely success of the future treatment and develop a prognostic factor.

Ideally, preoperative orthodontic treatment should be used to ensure a good postoperative occlusion as well as correcting any pre-existing malalignment of the teeth to enhance the cosmetic appearance of the patients. The objectives of presurgical orthodontic treatment for MMA patients are different from those of the routine orthognathic surgery for patients who have dentofacial deformities. In Class II patients, it is advisable to retract the lower incisor teeth and procline the upper incisor teeth to maximize the amount of mandibular advancement. This step will provide the greatest amount of airway improvement.

Oral appliances

In 1900, Pierre Robin first used oral appliances^[41] for glossoptosis. In 1990, adjustable mandibular advancement devices became the predominant form of dental therapy for SDB, signaling the entry of dentistry into mainstream sleep medicine. In 2000, a section of oral appliances was created in American Academy of sleep Medicine (AAOSM).^[42]

Now AAOSM has recommended oral appliances^[43-44] for primary snoring and mild-to-moderate OSA and patients intolerant to CPAP or those who refuse the surgery.

Various oral appliances [Figure 2] used in OSA are: mandibular advancement or mandibular retaining devices (MAD/MRD)—e.g., Herbst appliance, Snoreguard, Silencer—tongue retaining devices (TRD), e.g.—Snor Ex. Soft Palate Lifter—and a combination of Oral appliances and CPAP.

Oral appliances act by enlarging the obstructed upper airway, as they worn during the sleep; they enlarge the upper airway by moving the mandible and tongue anteriorly. It leads to the activation of upper airway dilator muscles which decrease the airway collapsibility. Hence, this action prevents the airway occlusion. In an AAOSM^[44] report, standard best practices for oral appliance treatment in OSA patients are:

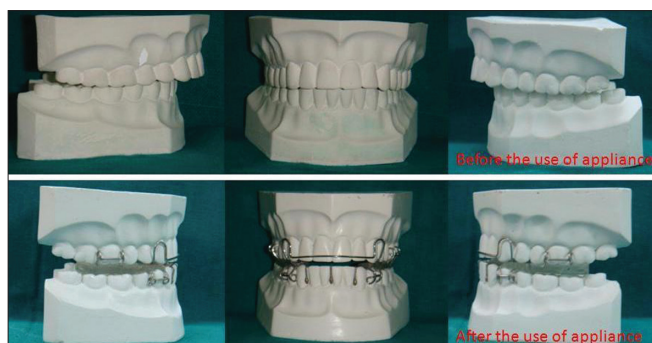


Figure 2: Oral appliance for the treatment of OSA

- To establish the presence or absence of OSA, using standard diagnostic criteria that include PSG before the decision to prescribe the oral appliances.
- To treat OSA patients to the desired outcomes of AHI < 5 events per hour and arterial oxyhemoglobin saturation levels >85% with the resolution of clinical signs and symptoms.

CONCLUSION

Hence the therapeutic interventions that are directed at the site of airway obstruction in the maxillofacial region are within the scope of dentistry. Dental practitioners can play a significant role in the treatment of OSA syndrome. It is imperative that the dental community continues to participate in the research and treatment of this serious and pervasive health problem.

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How to cite this article: Prabhat KC, Goyal L, Bey A, Maheshwari S. Recent advances in the management of obstructive sleep apnea: The dental perspective. *J Nat Sc Biol Med* 2012;3:113-7.

Source of Support: Nil. **Conflict of Interest:** None declared.

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