

# Principles of Prosthodontic Management of Sleep Apnea Syndrome

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**Abstract:**

Obstructive sleep apnea is a sleep disorder of airflow at the nose and mouth during sleep. It is a potentially hazardous condition and appropriate treatment should be strongly advised to all OSA patients. Dentist are becoming increasingly aware of the importance of detection and management of obstructive sleep apnea. Mandibular repositioning appliance plays an important role in management of OSA. This articles reviews etiology, clinical features, diagnosis and various treatment options with special reference to oral appliances how snoring can be controlled prosthodontically by different modalities of scientifically defensible

**Key words:** Dental implications, obstructive sleep apnea, AHI, oral appliances approaches.

**Introduction:**

We spend one third of our lives asleep and the quality of that sleep has a real impact on our quality of life. The understanding of the complex link between healthy sleep and brain and body function is relatively new. Sleep apnea is a potentially life-threatening sleep disorder characterized by repeated pauses in breathing during sleep. The term sleep apnea is derived from the Greek etymology meaning 'without breath'. Breathing

pauses can last anywhere from several seconds to minutes, and happen as often as 30 times or more per hour. Ongoing disrupted breathing causes an imbalance between the carbon dioxide and oxygen levels in the bloodstream, as not enough carbon dioxide is exiting and not enough oxygen is entering the body. 2

Sleep apnea is probably the most prevalent of all the sleep disorders and is classified as central, obstructive, or mixed; it may be mild, moderate, or severe. In central sleep apnea (CSA) there is a diminution of oxygen entry into the lungs due to the respiratory (chest) muscles failing to act as a result of a central nervous system disorder. OSA, the most prevalent of all the apneas, is a disturbance in normal sleep patterns and when combined with excessive day time sleepiness is termed obstructive sleep apnea syndrome (OSAS).3

Snoring is a common disorder caused by narrowing of the airway producing turbulence of the inspired or the expired air, causing the palate and other soft structures of the air lumen to flutter. Light intermittent snoring is ubiquitous in adult men and most women and although it could be a nuisance, it is not medically significant. On the other hand habitual snoring (continuous, every night) usually indicates the onset of OSA particularly in overweight men and requires medical attention.4

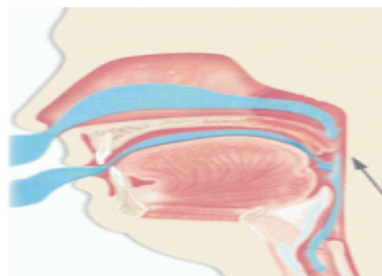


Fig. 1: Upper airway space of patient with normal anatomy, with unrestricted passage of air through upper airway ( Courtesy : Ivanhoe JR, Treatment of upper airway sleep disorder patients with dental devices, Quintessence 2000:215-31)

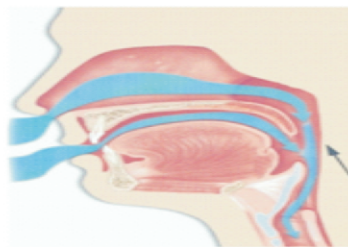


Fig. 2: Upper airway space of snoring patient demonstrates partial closure of airway space between tongue and posterior wall of pharynx and simulated vibration of uvula ( Courtesy : Ivanhoe JR, Treatment of upper airway sleep disorder patients with dental devices, Quintessence 2000:215-31)

It is evident from the uniqueness, high prevalence and multisystem involvement that the upper airway resistance syndrome cries for attention from the scientific community. Prosthodontists are more concerned with the management and resolution of this menacing

problem, as the aim of the prosthodontic specialty is to restore, rehabilitate and maintain oral and stomatognathic health and function, and this disorder seems to affect the harmony of the oral-stomatognathic region and challenges the general health of the individual.7

The purpose of this article is to review the anatomic features and etiologic factors of upper airway sleep disorders and medical and dental treatment options.

**Epidemiology:**

It is a major medical problem affecting 4% of the total elderly population. The prevalence increases dramatically with the increasing age.5 It has been reported that 10% of men and 5% of women in the 30-40 year age-group are habitual snorers; prevalence of snoring increases with age, reaching at least 20% for men and 15% for women in the 50-60 year age-group. Day time sleepiness is reported by at least 5% of men and 8% of women in the general population. The prevalence of OSAS is around 4% for men and 2% for women in the age-group of 30-60 years.6 Obese and overweight individuals have much higher chance of snoring or having obstructive sleep apnea.2

**Etiology and pathogenesis:**

OSA is characterized by a collapsing of the tongue back out the pharynx during sleep. Typically, this is because of large tongue, small air pathway or abnormal throat anatomy. This blockage restricts breathing, lowering the concentration of oxygen in the blood until receptors in carotid sinus are altered to higher CO2 levels in the body causing the patient to wake up and normal breathing is restored.

When a patient falls asleep in the supine position, the muscle relaxation causes the base of the tongue to approach the posterior wall of the pharynx. With the consequent reduced air flow,



the patient the patient must increase the speed of the airflow to maintain the required oxygen supply to the lungs. This increase in airflow velocity causes vibration of soft tissues, which produces snoring.<sup>3</sup>

The anatomical defects that contribute to the obstruction are adenotonsillar hypertrophy, retrognathia and macroglossia. Obesity frequently contributes to decrease in size of upper airway by increasing fat deposition or compressing the pharynx by superficial fat mass in the tongue.<sup>2</sup>

**Clinical feature:**

Sleep apnea is a chronic health problem and is also a progressive condition which means it can potentially worsen overtime. The signs and symptoms of OSA are as follows:

**Characteristic sign and symptoms of OSA: 1**

Nocturnal symptoms:	<input type="checkbox"/> Snoring <input type="checkbox"/> Witnessed apneas by bed partner <input type="checkbox"/> Nocturnal choking, snoring or gasping <input type="checkbox"/> Nocturnal reflux <input type="checkbox"/> Bruxism <input type="checkbox"/> Insomnia
Other nocturnal symptoms:	Enuresis, nocturia, frequent arousals, diaphoresis, impotence
Day time symptoms	Excessive day time sleepiness
Other day time symptoms	Fatigue, memory impairment, personality changes, morning nausea, morning headache, depression
Physical characteristic/ examination	<input type="checkbox"/> Obesity: Neck size > 17 inches (men) Neck size > 16 inches (women) BMI > 35 <input type="checkbox"/> Craniofacial anatomy: retrognathia, micrognathia, tonsillar hypertrophy, macroglossia, inferior displacement of the hyoid bone, narrowing of oropharyngeal airway, deviated nasal septum <input type="checkbox"/> TMJ derangement <input type="checkbox"/> Strong masticatory muscle activity <input type="checkbox"/> Hypertension: specially drug resistant

**Diagnosis:**

The diagnosis of OSA syndrome typically is formed by a comprehensive sleep history, presence of characteristic clinical feature , together with the objective demonstration of Sleep disorder.<sup>1</sup> It is not solely based on the above parameters but also requires demonstration of abnormal respiratory events with polysomnography (PSG) which is a gold standard. Some of widely used questionnaire are the Berlin Questionnaire, Epworth Questionnaire and STOP-Bang questionnaire.

The PSG yields AHI (Apnea Hypopnea index) that is apnea, hypopnea events divided by total sleep time in hours, which is use to determine The severity of OSA.<sup>1,2</sup>

**Grading of OSA: 1**

Severity	Grading
Mild OSA	AHI ≥5 and <15
Moderate OSA	AHI ≥15 and <30
Severe OSA	AHI ≥30

The multiple sleep latency test (MSLT) is used to establish how rapidly the patients falls asleep to distinguish it from narcoleps

The mallampati score (grade 1-4). There are 4 'grades', and the higher the grade, the smaller the air passage, which is another indicator of sleep disordered breathing, can be used as a predictor of sleep apnea particularly in cases where an enlarged tongue seems to be the cause for airway

obstruction.<sup>7</sup>

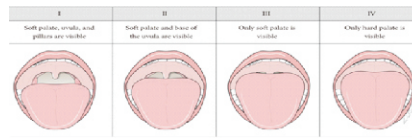


Fig 3: Mallampati Score

Lateral cephalometric radiographs reveal the diversion of airway column, position of hyoid bone and craniofacial skeleton for any maxillomandibular deficiencies. <sup>9</sup> Fibro-optic nasopharyngoscopy to examine three-dimensional structure of the airway revealing any anatomic site of obstruction.<sup>2</sup>

**Management of patient with OSA:**

OSA should be treated as a chronic disease requiring long term, multidisciplinary management. There are medical, dental behavioural and surgical treatment options.

**Options for treatment: 1**

1. Conservative approach: Positive airway pressure (PAP)  
 Pharmacologic treatment  
 Behavioural modification: Weight loss, Alteration in sleeping position  
 Oral appliance therapy
2. Surgical invasive approach: Genioglossus and tongue advancement  
 Maxillomandibular advancement  
 Laser assisted uvuloplasty (LAUP)  
 Tracheostomy  
 Uvulopalatopharyngoplasty (UPPP)

PAP is highly efficacious in terms of reduction of AHI and producing positive outcome, there has been significant criticism with regards to its expense, and local side effect at the nose or face, or discomfort due to the mask. Oral appliances has emerged as an alternative to CPAP



Fig 4: Continuous positive airway pressure (CPAP)

**Oral appliance therapy:**

Oral appliances find their greatest success when utilized for simple snoring, upper airway resistance syndrome and mild-to-moderate obstructive sleep apnea. A large literature review by Lowe showed that, as group's oral appliances were effective in mild-to-moderate OSA with 75% compliance rate.<sup>10</sup> Oral appliance therapy has been accepted by the American Sleep

Disorder Association as an appropriate treatment modality for OSA patient.

**Mechanism of oral appliances:**

Oral appliances function by repositioning the tongue and mandible forward and downwards to reduce airway collapse. The upper airway is divided in three regions: Velopharynx (hard palate to tip of uvula), Oropharynx (tip of uvula to tip of epiglottis) and hypopharynx (tip of epiglottis to vocal cords). The velopharynx is the most common site of primary pharyngeal collapse in OSA. The oral appliances has a lateral wall widening effect on the velopharyngeal and oropharyngeal space.<sup>1</sup>

**Types of oral appliances:**

Broadly classified as Mandibular Repositioning appliances (MRA), Tongue retaining devices (TRD), and soft palatal lifters.

MRA are further classified as custom made and prefabricated appliances.

Some of the prefabricated oral appliances are as follows:<sup>1,11</sup>

Somnomed	Aveo-TSD	Silent nite
The silencer	Klearway	Snore guard
TAP	Esmark	EMA
SNOAR	Therasnore	Respire

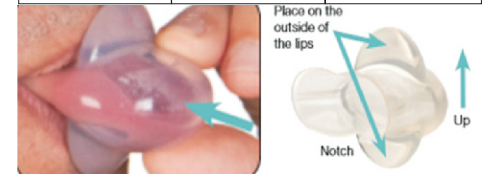


Fig 5: Aveo-TSD



Fig 6: TAP (Thornton Adjustable Positioner)

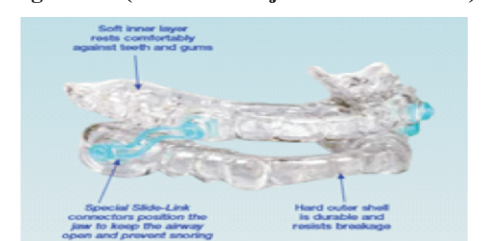


Fig 7: Silent nite

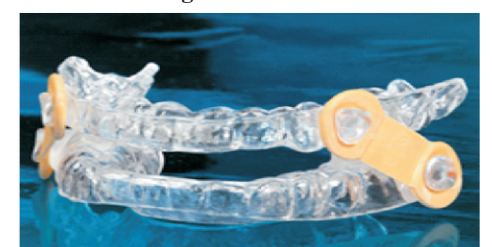


Fig 8: EMA

It is found that there is superior treatment

response with custom made appliances over prefabricated appliances.1,2,3 The custom made appliances includes:

For dentulous patients: Maxillary and mandibular vacuum-formed splints  
Heat polymerized and latched 2-part splint  
Twin block appliance

Herbst appliances

For edentulous patients: Maxillary and mandibular vacuum-formed splints.

Dentures with and without increased vertical dimension Loss or absence of teeth produces prominent anatomical changes that may influence upper airway size and function, such as loss of the vertical dimension of occlusion resulting into reduction of height of the lower face and mandibular rotation. Rehabilitation of edentulous patients with complete dentures is an integral part of prosthodontic treatment. A denture not only provides esthetics and improves the phonetics but also restores the desired function of mastication and also provides adequate support to orofacial structures by restoring altered vertical dimension of face. Besides, it also improves OSA/hypopnea.9

The Cephalometric Evaluation of the Effect of Complete Dentures on Retropharyngeal Space and Its Effect on Spirometric Values in Altered Vertical Dimension using occlusal jig and concluded that there was marked increase in the values more than the values observed in same subjects wearing complete dentures with acceptable vertical dimension of occlusion.9



Fig 9:Occlusal jig



Fig 10:Occlusal surface registered with putty



Fig 11:Increased vertical dimension using jig

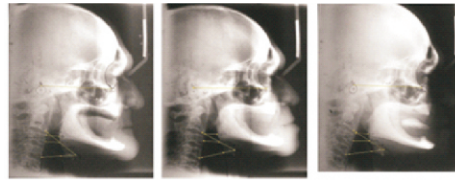


Fig 12:1. Cephalogram of edentulous state  
2. With acceptable VD  
3. With increased VD

Suresh Nayar, Jeremy Knox 5 given a simple technique for fabrication of mandibular advancement appliance for edentulous patient without increase of vertical dimension which is simple and easy to use.



Fig 13:Mandibular advancement appliance for edentulous patient 5

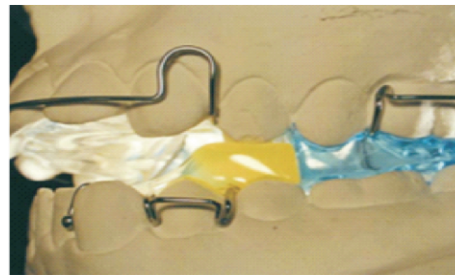


Fig 14:Twin Block appliance

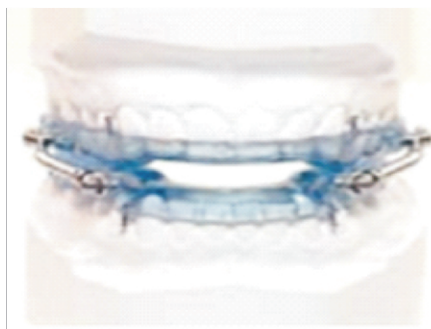


Fig 15:Herbst appliance

<b>Advantages of oral appliances: 12</b>
Noninvasive
Lack of noise
Simplicity
Reversible treatment modality
Smaller and more portable than PAP
No need for power source
Comfortable: fits inside mouth
Lower cost

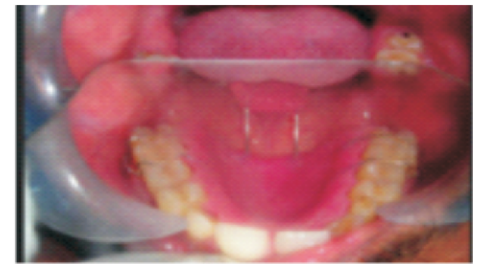
Soft Palate Lift Appliances:

Those that lift the soft palate are rarely used because of gag, discomfort and success of laser and radiofrequency soft palate procedures. A recent study by Venket R et al describes the use, four new prosthodontic appliances for managing sleep apnea namely uvula lift appliance, uvula and velopharynx lift appliances, nasopharyngeal

aperture guard and soft palate lift appliance and a conventional mandibular advancement appliance. He concluded that nasopharyngeal aperture guard appliances was the best among the five types of appliances.7



Fig 16: 1.Uvula lift appliance



2. Velopharynx and Uvula lift appliance



3.Nasopharyngeal aperture guard appliance



4.Soft palate lift appliance



5.Mandibular advancement and tongue positioning appliance

**Discussion:**

The indication for use of MRA is to treat snoring. MRA is effective in a substantial number

of patient with mild to moderate OSA and to much lesser degree in those with severe OSA. A referral is needed from the physician to the dentist based on clinical history and findings and PSG .Response to the treatment can be somewhat predicted based on patient preexisting conditions, severity and protrusive capacity of the mandible. Protrusion is necessary to make MRA effective. The most common mandibular repositioning dimension quoted is 50 to 75% of maximal protrusion (Approximately 5-7 mm).<sup>7</sup>

The advantage of using dentures in edentulous patient during sleep resulted in reducing apnea-hypopnea events in edentulous obstructive sleep apnea patient. This occurred due to the fact that wearing dentures induces modifications in the position of the jaw, tongue, soft tissue, and pharyngeal airway space that may contribute to the reduction of apnea events. Moreover, since wearing complete dentures might not change the horizontal mandibular position as oral appliance do, it might help to restore the vertical mandibular position. Thus, the denture itself can act as an oral appliance and provides esthetic look to the patient.<sup>13</sup>

The disadvantages of wearing dentures during sleep are due to the fact that they are associated with chronic inflammatory changes, leading to irritation and alveolar bone resorption in the denture-supporting area. In addition, increasing the vertical dimension of occlusion can cause strain on temporomandibular joint, and patient may need more time for adaptation to the same.<sup>14,9</sup>

Johal and Battagel<sup>17</sup> stated that increased vertical dimension decreases the posteropharyngeal space but mandibular advancement appliance bring the forward and downward movement of mandible with posterior movement of tongue and soft palate.

Marklund et al<sup>15</sup> found MADs satisfactorily treated patients with mild and moderate sleep apnea but had poor results with those classified as severe. They have suggested that oral devices may not address larger obstructions in the upper airway, perhaps extending to the epiglottis, and this may account for their decreased success in these patients. Powell et al<sup>16</sup> believe this may also account for the low success rate in treatment with UPPP.

Oral devices are not a panacea; many patients may not achieve satisfactory results and oral devices can cause dental complications, including TMJ sensitivity, loss of posterior occlusion, tooth movement, tooth sensitivity, and loss of existing restorations. It is even possible that an oral device may exacerbate an existing OSA. Fortunately, most of these conditions are transient with the newer adjustable oral devices. An informed consent (Fig. 9) describing these possibilities is absolutely necessary for all patients, including the recommendation that an overnight polysomnography study be completed.

**Conclusion:**

OSA is a serious disease with significant morbidity and should be treated aggressively. It is

a common condition but a large number of patients remain undiagnosed. In spite of significant advances its management in adults remains challenging. State of the art treatment requires a multidisciplinary approach. The team of experts should be headed by a physician specializing in Sleep Medicine and should include an Otolaryngologist, an Oral-Maxillofacial Surgeon, and a Prosthodontist. C-Pap is the primary mode of treatment and is universally successful. Patient compliance, however, is low. Weight loss and life-style changes can be curative in cases of mild apnea.<sup>4</sup> Because of the established training in TMD ,removable appliance therapy and occlusion, prosthodontic is uniquely suited to educating dental students in sleep disorder and oral appliance therapy. Prosthodontist can set new standard in developing more in depth dental sleep medicine training with access to multidisciplinary teams and to ensuring that dental sleep medicine continues to strive for excellence in management of sleep apnea with oral appliances.<sup>1</sup>

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