



Research Article

MANAGING OBSTRUCTIVE SLEEP APNEA: A PROSTHODONTIST'S WAY

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ABSTRACT

Sleep disorders are common and can have serious consequences on patient's health and quality of life. Although dental sleep medicine is a relatively new field, major research and clinical advances continue rapidly. Dentist are becoming increasingly aware of the importance of detection and management of obstructive sleep apnea. As prosthodontists are commonly associated with temporomandibular joint and its disorders, occlusion and removable appliances, they can play a pivotal role in the management of obstructive sleep apnea. This article aims to highlight the role of prosthodontist in the management of obstructive sleep apnea and its prosthodontics management.

Key words:

sleep, apnea, obstructive, prosthodontic, management

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INTRODUCTION

Sleep is a universal function of living species and is needed to maintain optimum health and performance. Poor-quality sleep is often associated with an increased health problems causing a wide variety of dysfunction in most body systems, including endocrine, metabolic, higher cortical function, and neurological disorders. Disorders of sleep can manifest as complaints of either insufficient sleep, excessive amount of perceived sleep, or abnormal movements during sleep. ¹Sleep apnea is probably the most prevalent of all sleeping disorders. The term sleep apnea is derived from the Greek etymology meaning 'without breath'. It is a potentially hazardous condition and appropriate treatment should be strongly advised to all OSA patients.²

Brief history: George Cattlin was the first person to relate the influence of sleep quality on daytime function. Following his work; many devices were patented to promote nasal breathing. Pierre Robin (1903) first documented and described his device "monoblock" for the treatment of glossoptosis. Years later, Cartwright and Samelson (1982) described the tongue retaining device (TRD).³

Classification of sleep disordered breathing: Sleep disordered breathing is classified as followed:

Obstructive breathing disorders: It is further classified as:

1. Upper airway resistance syndrome
2. Obstructive sleep apnea

Non-obstructive breathing disorders: It is further classified as:

1. Central apnea
2. Sleep or obesity related hypoventilation syndrome

Obstructive sleep apnea: Obstructive sleep apnea (OSA) is a repetitive upper airway (pharyngeal) collapse at the level of the soft palate or base of tongue during sleep. This condition can lead to a complete cessation of breathing for 10 seconds or more (apnea) or partial collapse (hypopnea) of the airway, resulting in an arousal. OSA causes both fragmented sleep and oxygen desaturation (exceeding 3%). The resultant effect of this decreased airflow is episodic oxygen desaturation, sleep fragmentation, and marked negative intrathoracic pressures (Fig 1 & 2).²

Clinical signs & symptoms

Nocturnal symptoms

- Snoring
- Witnessed apneas by bed partner
- Nocturnal gasping, choking
- Insomnia
- Nocturnal reflux
- Nocturnal enuresis
- Frequent arousals
- Diaphoresis
- Impotency

Daytime symptoms

- Excessive daytime sleepiness

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- Fatigue
- Mood disturbances
- Memory impairment
- Personality changes
- Morning nausea
- Morning headaches
- Depression

Craniofacial changes associated with OSA²

- Retrognathia
- Micrognathia
- Tonsillar hypertrophy
- Macroglossia
- Inferior displacement of the hyoid bone,
- Narrowing of oropharyngeal airway

Adverse outcome associated with OSA²

- Impaired glucose and lipid metabolism, systemic inflammation
- Cardiovascular disturbances: hypertension, stroke, congestive heart failure, arterial fibrillation
- Increased risk of motor vehicle accidents
- Impaired quality of life
- Cognitive impairment

Diagnosis of OSA: OSA can be diagnosed by using the following measures:²

1. Polysomnography
2. Evaluation of AHI index
3. Comprehensive sleep history
4. Evaluation of characteristic clinical features
5. Self reported questionnaire: Berlin and Stop Bang questionnaires
6. Mallampati classification for palato-pharyngeal region
7. Interviewing of the bed partner

Polysomnography (PSG): PSG is the “gold standard” for the diagnosis of OSA. PSG requires the recording by technical personnel with sleep-related training and the monitoring of the following physiologic signals: Electroencephalogram; Electrooculogram; Nasal pressure; Oral or oronasal thermistor; Oxygen saturation; Respiratory effort; Electrocardiogram; Electromyogram; Audio, video.

The AHI index: The PSG provides an AHI (Apnea Hypopnea index) that is apnea, hypopnea events divided by total sleep time in hours, which is used to determine severity of OSA. OSA is defined when the AHI is ≥ 5 and OSA syndrome when AHI ≥ 5 is accompanied with daytime sleepiness (Table 1).

The Mallampatti classification for palato-pharyngeal region

The American Academy of Sleep Medicine recommends assessing the modified Mallampati score when screening for sleep apnea and should be incorporated into dental practice as well. This assessment is preferably done with the patient in an upright position. Protruding the tongue helps view the extent of tongue length and may improve visualization of tonsillar pillars, length of soft palate, and the posterior oropharynx. The base of the uvula and the appearance of the soft palates are visualized and scored. A high score (class 3 or 4) is a predictor of sleep apnea (Fig 3).

Role of Prosthodontist in diagnosis, patient education & prevention of obstructive sleep apnea: The dentist now has an ever-increasing role in the recognition of a patient who may be at risk for a sleep disorder. Increased age is often associated with an increased chances of developing OSA.¹⁵ Thus, prosthodontists who are more truly “Gerodontologists” can play an important role in the diagnosis and prevention of OSA. The dentist should however know that not everyone who snores has sleep apnea, and not everyone who has sleep apnea snores. While intervening, if the patient responds positively for morning headaches, excessive daytime sleepiness, irritation and anxiety at work he is more likely to suffer from OSA. If suspicious, the prosthodontist can get it confirmed by evaluating the presence of various intra oral conditions that may be associated with OSA.

Oral conditions that can lead to OSA²

- Mandibular tori
- Macroglossia
- Steep soft palate
- Retro or micrognathia
- Loss of verticle dimension
- V shaped arches

If a patient shows any of the above mentioned oral feature, he or she can be considered as high risk for developing OSA. All the patients who are at high risk of developing OSA or are suffering from mild OSA should be counselled and explained in detail the associated risk factors of OSA and their high prevalence for developing systemic disorders like hypertension, diabetes, atrial fibrillation, cardiac failure.⁴ The importance of good systemic health on quality of life should be explained to these patients. Patients should also be warned about the high risk of motor vehicle accidents associated with OSA. A referral should be made to sleep medicine physician for the confirmation of the diagnosis by a PSG test. Meanwhile, prosthodontist can suggest the following preventive measures to treat mild OSA cases:-

Recommended Lifestyle changes

Lose weight: People who are overweight have extra pharyngeal fat deposits which can lead to a decrease in pharyngeal patency. Weight reduction will lead to a decrease in critical closing pressure and consequently decreases the severity of OSA.⁵

Quit smoking: Smoking contributes to sleep apnea by increasing inflammation and fluid retention in upper airway. Smoking cessation appears to decrease the risk OF OSA.

Avoid alcohol, sleeping pills, and sedatives: specially before bedtime, because they relax the muscles which may interfere with breathing.

Exercise regularly: Tongue muscle training by electrical stimulation and oropharyngeal exercise may limit the effects of snoring and respiratory disturbances.⁵

Sleep on your side: Patients should be advised to sleep on their side to prevent the tongue from falling back.

Avoid caffeine: while going to bed as caffeine acts as a CNS stimulant and may lead to sleep disruptions.

Maintain regular sleep hours: Sticking to a steady sleep schedule will help to relax and sleep better.

Treatment of obstructive sleep apnea: OSA should be treated as a chronic disease requiring long-term, multidisciplinary management. There are medical, dental, pharmacological, behavioural and surgical treatment options. In many cases there is a primary treatment modality that is supported with adjunctive therapies to manage the condition. The patient often performs a vital role in managing his or her own treatment and should be actively involved in understanding the severity of the OSA, their risk factors, and the methods of treatment.

The continuous positive airway pressure (CPAP): PAP was first reported in 1981 and provides pneumatic splinting of the upper airway and still remains the gold standard treatment of OSA. Two types of masks are available: oral and naso-oral masks. CPAP is highly efficacious in treating OSA but it is associated with several disadvantages like its expense, noise, local side effects at the nose or face, and discomfort due to the mask. Excessive tightening of the mask can sometimes displace the mandible and the tongue posteriorly which may worsen the apnea. These side effects have led to the search for other treatment options for treating OSA.²

Surgical procedures: Various surgeries available for treating OSA are tracheotomy, uvulopalatopharyngoplasty, laser assisted palatoplasty, tonsillectomy, radiofrequency ablation, pillar palatal implants, lingualplasty, hyoid suspension, palatopharyngoglossoplasty, vulopalatopharyngoglossoplasty, bariatric surgery. Advances in surgically implanted devices show promise in both animal and human models but are not yet available for routine use.^{2,5}

Behavioral modification: It includes weight loss, alcohol avoidance, alteration of sleeping position.

Oral appliance therapy: Oral appliance therapy has emerged as an alternative to CPAP for snoring and mild to moderate OSA in patients who refuse or fail to adhere to the use of CPAP device. Although the oral appliances seem to be less efficacious than CPAP, in instances when both treatments are effective, patients usually prefer oral appliances over CPAP. Oral appliance therapy has been accepted by the American Sleep Disorder Association as an appropriate treatment modality for OSA patients.²

Types of oral appliances: Classes of oral appliances for treating OSA are presented in Table 2.

The mandibular repositioning appliance (MRA): The MRA are most commonly used oral appliances for the treatment of OSA. Most MRA's use traditional dental orthodontic appliance design and involve a 1- or 2-piece appliance that is retained by one or both dental arches. Design features can include metallic rod and tube fittings, inter-arch elastic, metal or plastic connectors, or even magnets. It is stated that superior treatment response is usually seen with custom-made MRA appliances.²

Mechanism of Action of MRA: MRA functions by repositioning the mandible antero-inferiorly; which indirectly brings the tongue forward opening up the posterior airway and thus reduce airway collapse. MRA holds the mandible in an advanced position with respect to the resting position. The MRA has a lateral wall widening effect on the velopharyngeal and oropharyngeal spaces, improves the upper airway patency,

reduce snoring and AHI index, and thus reduces OSA. MRA's aids to improve physiology of the individual, also reduces daytime sleepiness and thus improves quality of life. Quality of life may further improve because of sleep improvement of bed partner.²

Some commonly used oral appliances for the treatment of obstructive sleep apnea^{2,5,6,8}

Simple maxillomandibular splint: It is a simple splint which helps in keeping the mandible in pre-recorded protrusive position and can be used in the edentulous patients suffering from OSA. Its disadvantage is poor retention thus decreasing its efficiency (Fig 4).

Karwetzky appliance: It is a tooth & tissue-borne activator which is split along the occlusal plane & joined by U bow in the first molar region. This design permits vertical & lateral jaw movements during sleep. This type of activator allows stepwise advancement of the mandible by adjusting the U loop (Fig 5).

Twin block appliance: The twin block appliance consists of an upper & lower bite plane at an angle of 45°. The upper bite block covers the lingual cusps of upper posterior teeth extending anteriorly till mesial ridge of upper second premolar. The lower bite block extends distally upto the distal marginal ridge of second premolar. The appliance causes mechanical advancing of the mandible (Fig 6).

Herbst appliance: Herbst appliance is a fixed functional appliance developed by Emil Herbst in early 1900s. The device consists of a tube into which the plunger (rod) fits. The tube is fixed to the distal end of the maxillary molars while the rod is fixed to the lower first premolars. A bilateral telescopic mechanism keeps the mandible mechanically in continuous anterior position (Fig 7).

Thornton Adjustable Positioner (TAP): The TAP is a mandibular repositioning appliance that makes use of titrating screw to adjust mandibular position incrementally till the time subjective improvement in snoring & objective improvement in PSG is achieved (Fig 8).

Silent nite: Silent Nite-sl is a mandibular repositioning appliance that works using special Slide-Link connectors attached to upper and lower splints. These custom-made splints are comprised of a soft, comfortable inner layer with a hard, durable outer layer (Fig 9).

Myerson Elastic Mandibular Advancement (EMA) appliance: EMA appliance is a simple, patient-friendly oral appliance that provides quick and easy adjustments. The mandibular advancement is achieved with the aid of elastic straps of varying degrees of elasticity and length. The elasticity of the straps provide a freedom of movement to the mandible and reduces the occurrence of temporomandibular joint dysfunction and pain associated with similar appliances currently used in treating OSA (Fig 10).

Tongue retaining devices (TRD): The TRD's objective is to maintain the tongue in a forward position. The tongue is secured into an anterior bulb of the device by creating a negative pressure and thus widen the upper airway dimensions during sleep. Because the teeth are not used for anchorage of the device, TRDs are proposed as a treatment option for

patients with hypodontia, edentulism, and significant periodontal disease. TRDs are poorly tolerated and are not often recommended but may be considered in patients with TMD who cannot tolerate any jaw advancement (Fig 11).

The palatal lift prosthesis: These kind of prosthesis lifts and/or stabilizes the soft palate, preventing vibration during sleep. This appliance can be used in cases where soft palate is the cause for snoring, as it enables the lifting of soft palate. Uvula lift appliance can be used in cases where elongated or bifid uvula is the cause for upper airway obstruction (Fig 12).

Results of Clinical Trials on the Efficacy of Oral Appliances

Most of the studies in the literature states that oral appliances are effective way to manage mild to moderate cases of OSA and provides a greater deal of patient satisfaction and comfort when compared to other treatment modalities thus improving the quality of life of the patients.⁷⁻¹⁰

Oral appliances in partially edentulous patients: Studies state that oral appliance therapy such as monobloc appliances and PM positioners can be used as promising tools for treating the partially edentulous patients with OSA.^{11,12}

Edentulism & obstructive sleep apnea: Obstructive sleep apnea is commonly seen in elderly. Studies state that 61% of patients older than 50 years of age are estimated to meet the minimum criteria for OSA (AHI > 5). Epidemiological studies estimate that edentulism troubles about 18% of patients older than 60 years.¹³ Considering the high prevalence of OSA in the advanced age, it is conceivable that elderly people are at risk of developing edentulism-induced OSA and consequently OSA related morbidity and mortality. Present knowledge suggests that edentulism acts through complex mechanisms, ranging from simple anatomical changes to impairment of neural reflexes and neuromuscular activity. The loss of natural teeth causes a reduction in vertical dimension of occlusion, reduction of the lower face height, change in the position of mandible and hyoid bone, loss of tone in soft palate and pharynx that may all affect the airway area and respiration. Moreover, long lasting edentulism causes abnormal tongue position, impairs tongue motor skill and favors macroglossia. As tongue fills the space of missing natural teeth it causes the retrolingual space obstruction and may lead to OSA.^{14,15}

Dentures & obstructive sleep apnea: The nocturnal use of dentures may prevent or protect patients from the predisposing factors of OSA. Dentists generally recommend to remove dentures during the night, to limit the risk of denture irritations & provide appropriate tissue rest. However, the advantages of removing dentures during sleep should be weighted against the risk of favouring upper airway collapse.¹⁵ Retropharyngeal space significantly decreases by removing dentures.¹⁶ Various studies have shown that when the patients wears dentures while sleeping a significant improvement in AHI and mean oxygen saturation is observed.^{17,18} Studies also state that wearing denture induces modifications in the position of the tongue, mandible and retropharyngeal airway space which can favor the reduction of apnea episodes.^{19,20}

Implant supported oral appliances for completely edentulous patients: MRA require retention in the patient's dentition, therefore edentulous OSA patients generally do not qualify for this treatment. To improve retention, implant retained mandibular repositioning appliance (MRA) can be used as a viable treatment modality for edentulous OSA patients.²¹

Advantages of oral appliances²

- Simpler
- Noninvasive
- Noiseless
- Reversible treatment modality
- Smaller and more portable than CPAP devices
- Power source not required
- More comfortable than CPAP devices
- Potentially lower cost of treatment

Adverse events of oral appliance therapy^{2,5}

- Temporomandibular joint pain
- Myofacial pain
- Tooth pain
- Occlusal changes
- Dry mouth
- Loss of crown or restorations
- Tongue pain with TRDs
- Gagging with soft palatal lifters
- Tooth mobility
- Skeletal changes- changes in vertical condylar position, change in arch width

Relative contra-indications for oral appliance therapy²

- Periodontal diseases
- Temporomandibular dysfunction
- Less teeth per arch
- Less protrusive capacity of mandible
- Bruxism
- Reduced verticle mouth opening
- Exaggerated gag reflex

CONCLUSION

Continuous positive airway pressure (CPAP) remains the first line of treatment for sleep apnea, but in cases where CPAC cannot be used oral appliance therapy plays an important role. With their advanced knowledge, training and expertise in occlusion, temporomandibular joint (TMJ) function and removable appliances; prosthodontists plays an important role in the diagnoses and management of obstructive sleep apnea. Although the role played by the prosthodontists is still in its budding stage but with better understanding and knowledge, the prosthodontists in near future will contributed immensely towards prevention and treatment of OSA in colliation with the patient and sleep medicine physician to improve the quality of life of such patients.

Table 1 The AHI index for diagnosing OSA

Sr. No	Severity	Grading
1.	Mild OSA	AHI ≥ 5 and ≤ 15 per hour sleep
2.	Moderate OSA	AHI ≥ 15 and < 30 events per hour sleep
3.	Severe OSA	AHI ≥ events per hour sleep

Table 2 Types of oral appliances for treating OSA

Mandibular repositioning appliances (MRA)	a.	Custom made appliance
	i.	For edentulous patients Eg: Karwetzky appliance Twin block appliance Herbst appliances
Tongue repositioners	ii.	For edentulous patients Eg: Maxillary and mandibular vacuum-formed splints
	b.	Pre-fabricated appliances Eg: Thornton Adjustable Positioner (TAP), Silent night, Myerson Elastic, Mandibular Advancement (EMA) appliance, NAPA, SNOAR, TAP, The silencer, Snore guard, PM positioner, Snore Ex
Soft palatal lifters The equalizer The magnetic appliances	a.	Tongue retainers
	i.	Tongue retaining devices (TRD)
	ii.	Tongue locking devices (TLD)
	i.	Tongue posture trainers
	ii.	Tepper oral proprioceptive simulator (TOPS)
	ii.	Tongue positioner and exerciser (TPE)

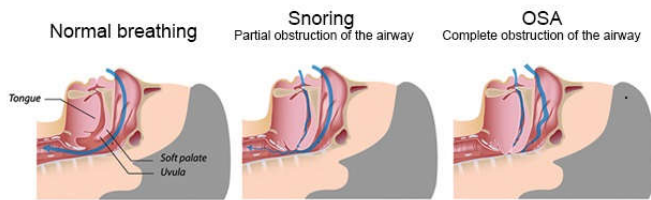


Figure 1 Diagrammatic representation of OSA

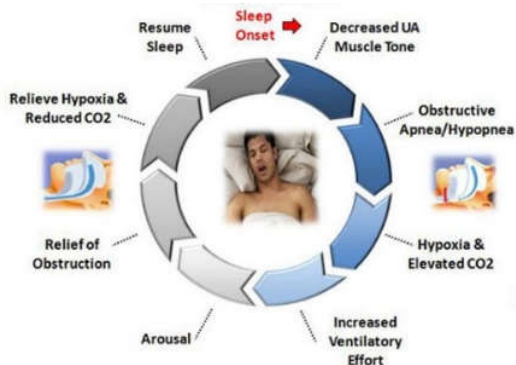


Figure 2 OSA cycle

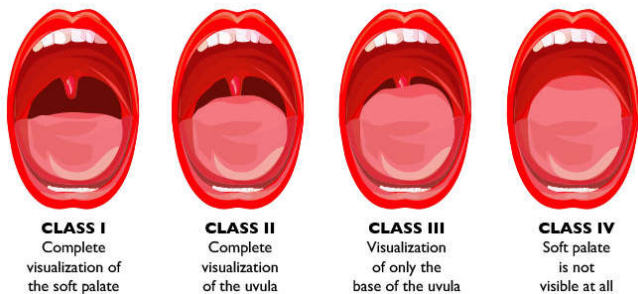


Figure 3 Mallampati Classification for palato-pharyngeal assessment



Figure 4 Simple Maxillomandibular splint (MRA for edentulous OSA patients)

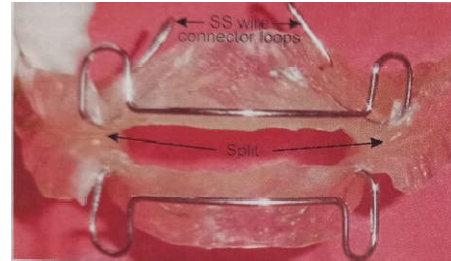


Figure 5 Karwetzky appliance



Figure 6 Twin Block appliance

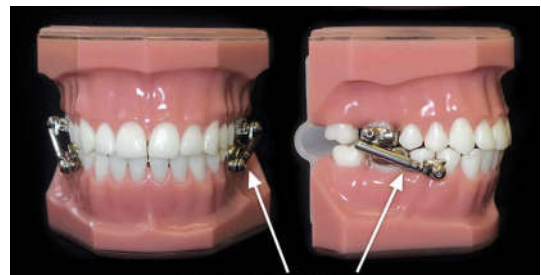


Figure 7 Herbst appliance

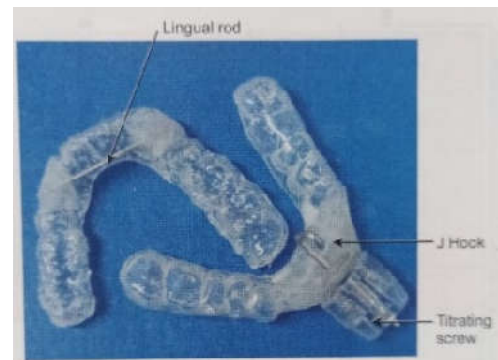


Figure 8 TAP



Figure 9 Silent nite-sl



Figure 10 EMA



Figure 11 Tongue-retaining device



Figure 12 Palatal lift prosthesis

References

1. Pavlova, M. K., & Latreille, V. 2019. Sleep disorders. *The American Journal of Medicine*, 132(3): 292-299.
2. Barewal RM, Hagen CC. 2014. Management of snoring and obstructive sleep apnea with mandibular repositioning appliances: a prosthodontic approach. *Dental Clinics of North America*, 58(1):159-80.
3. Annapurna K, Suganya S, Vasanth R, Kumar PR. 2014. Prosthodontic approach to treat obstructive sleep apnea. *Annals of Medical and Health Sciences Research*, 4(4):481-486.
4. Tanigawa, T. 2011. Obstructive sleep apnea: its prevention and screening may contribute to the prevention of hypertension, diabetes and cardiovascular diseases. *EPMA Journal*, 2(1):83-89.
5. Randerath, W. J., Verbraecken, J., Andreas, S., Bettega, G., Boudewyns, A., Hamans, E., & Stuck, B. A. 2011. Non-CPAP therapies in obstructive sleep apnoea. *European Respiratory Journal*, 37:1000-1028
6. Kharbanda OP. *Orthodontics: Diagnosis & Management of Malocclusion & Dentofacial Deformities*. Elsevier Health Sciences; 2013. Chapter 47, Orthodontist's role in upper airway sleep disorders. Pg 540-552.
7. Kyung SH, Park YC, Pae EK. 2005. Obstructive sleep apnea patients with the oral appliance experience pharyngeal size and shape changes in three dimensions. *Angle Orthodontists*, 75(1):15-22.
8. Bloch KE, Iseli A, Zhang JN, Xie X, Kaplan V, Stoeckli PW, et al. 2000. A randomized, controlled crossover trial of two oral appliances for sleep apnea treatment. *American Journal of Respiratory and Critical Care Medicine*, 162:246-51.
9. Barnes M, Mc Evoy RD, Banks S, et al. 2004. Efficacy of positive airway pressure and oral appliance in mild to moderate obstructive sleep apnea. *American Journal of Respiratory and Critical Care Medicine*, 170:656-664.
10. Gale DJ, Sawyer RH, Woodcock A, Stone P, Thompson R, O'Brien K. 2000. Do oral appliances enlarge the airway in patients with obstructive sleep apnoea? A prospective computerized tomographic study. *European Journal of Orthodontics*, 22:159-68.
11. Ogawa T, Ito T, Cardoso MV, Kawata T, Sasaki K. 2009. Treatment using oral appliance for obstructive sleep apnea syndrome patients with multiple missing teeth. *Sleep Medicine*, 10:809-811.
12. Giannasi LC, Magini M, Costa MS, Oliveira CS, Oliveira LV. 2010. Oral appliance treatment for obstructive sleep apnea in a partly edentulous patient. *American Journal of Orthodontics Dentofacial Orthopaedics*, 137(4):548-551.
13. Douglass CW: 1990. Prosthodontics 21. Clinical practice: Delivery of services. *Journal of Prosthetic Dentistry*, 64:275-283.
14. Mohan, S. M., Gowda, E. M., & Banari, A. S. 2015. Obstructive sleep apnea (OSA): A prosthodontic perspective. *Medical journal armed forces India*, 71:395-399.
15. Bucca, C., Cicolin, A., Brussino, L., Arienti, A., Graziano, A., Erovigni, F., & Rolla, G. 2006. Tooth loss and obstructive sleep apnoea. *Respiratory research*, 7 (1):8.
16. Bucca, C. B., Carossa, S., Colagrande, P., Brussino, L., Chiavassa, G., Pera, P., & Preti, G. 2001. Effect of edentulism on spirometric tests. *American journal of respiratory and critical care medicine*, 163(4):1018-1020.
17. Bucca C, Cicolin A, Brussino L, Arienti A, Graciano A, Erovigni F. 1999. Edentulism and worsening of obstructive sleep apnoea. *The Lancet*, 353:121-122.
18. Arisaka H, Sakuraba S, Tamaki K, Watanabe T, Takeda J, Yoshida K. 2009. Effect of wearing complete dentures during sleep on the apnea-hypopnea index. *International Journal of Prosthodontics*, 22:173-177.
19. Erovigni F, Graziano A, Ceruti P, Gassino G, De Lillo A, Carossa S. 2005. Cephalometric evaluation of the upper airway in patients with complete dentures. *Minerva Stomatol*, 54:293-301.
20. Gupta P, Thombare R, Singhal S, Pakhan AJ. 2010. Obstructive sleep apnea and edentulism-role of complete dentures/oral appliance from prosthodontic perspective: a review. *Indian Journal of Sleep Medicine*, 5:116-119.
21. Hoekema A, Vries FD, Heydenrijk K, Stegenga B. 2007. Implant retained oral appliances: a novel treatment for edentulous patients with obstructive sleep apnea-hypopnea syndrome. *Clinical Oral Implants Res*, 18 (3):383-387.
