The journal of
PROSTHETIC AND IMPLANT DENTISTRY
Official Publication of Indian Prosthodontic Society
Kerala State Branch

OBSTRUCTIVE SLEEP APNEA AND ITS PROSTHODONTIC MANAGEMENT: A DENTAL OUTLOOK

*Navya N B, **Sanjayagouda B Patil, *Abhilasha S B, *Ankitha Thejus

*Postgraduate, **Professor and Head, Department of Prosthodontics, Crown and Bridge including Implantalogy, Sri Hasanamba Dental College and Hospital, Vidynagar, Hassan – 573202, Karnataka. | Corresponding Author: Dr. Navya N B, Email: navyanb11@gmail.com

https://doi.org/10.55231/jpid.2023.v07.i01.05

Abstract

Obstructive sleep apnea (OSA) is the most common sleep-related breathing disorder with periodic reduction or cessation of airflow during sleep. Prevalence of obstructive sleep apnea is favored in men more than woman. Risk factors include nasal obstruction, obesity, gender, craniofacial anatomy, and smoking. Polysomnography is proved to be the golden-standard method for diagnosing obstructive sleep apnea. Treatment of OSA varies from simple measures such as oral appliances and nasal continuous positive airway pressure (CPAP) to surgical procedures. Oral appliance, namely, mandibular advancement device (MAD) is the recommended treatment appliance for the patient with mild to moderate OSA. For the dental profession in general and in prosthodontists speciality, the subject of sleep medicine continues to offer great challenges and opportunities in diagnosis, treatment planning, and treatment based on qualitative evidence. This article discusses the various aspects and prosthodontic perspectives of obstructive sleep apnea in detail.

Keywords- Obstructive sleep apnea, predisposing factors, symptoms, polysomnography, oral appliances.

Introduction

Obstructive sleep apnea is the most common respiratory disease associated with chronic insomnia.[1] OSA is defined as the condition of repetitive episodes of complete or partial collapse of the upper airway during sleep that is followed by transient awakening, which results in restriction of the upper airway permeability.[2] Airway obstruction can occur in many areas of the nasopharynx, oropharnyx, and hypopharynx. The severity of OSA is expressed as the Apnea Hypopnoea Index (AHI). It is the number of apneas and hypopneas per hour of sleep. Due to the multifactorial nature of this condition, management includes a multidisciplinary approach.[3] The role of prosthodontists is becoming more significant in treating sleep disorders especially in patients with mild to moderate obstructive sleep apnea (OSA).[1] They should recognize the signs and symptoms of OSA, refer to the physician for diagnosis, and collaborate with the health team surrounding the patient in providing care that will improve the patient's oral and general health.[4]

Epidemiology:

It has been reported that 10% and 5% of men and women, respectively, in the 30–40-year age group are common snorers, reaching at least 20% for males and 15% for females in the 50-60 year age group. It has been reported that 5% of the world population is affected by OSA, with the prevalence of 4% for men and 2% for women in the age of 30-60 years.[1]

Predisposing factors:

Obesity is an important risk factor for obstructive sleep apnea (OSA). Among the severely obese, the prevalence of OSA ranges from 55% to 100%. Craniofacial anomalies like micrognathia and retrognathia, enlarged palatine tonsils, enlarged uvula, high-arched palate, nasal septal deviation, longer anterior facial height, steeper and shorter anterior cranial base, inferiorly displaced hyoid bone, disproportionately large tongue, a long soft palate, and decreased posterior airway space also predispose to obstructive sleep apnea.[5] In addition to age, genetic, ethnic and gender predilection and various habits such as alcohol consumption, smoking and drugs use, the existing OSA is aggravated.[1]

Pathophysiology:

The upper airway is a soft tissue tube, the patency of which is maintained, in part, by muscles such as tensor veli and genioglossus. The base of the tongue obstructs the upper airway resulting in snoring. The upper airway is composed of the nasopharynx, oropharynx, and hypopharynx. When the patient falls asleep in the supine position, muscle relaxation causes the base of the tongue to approach the posterior wall of the pharynx. With the consequent reduction of airflow, the patient must increase the airflow speed to maintain the required oxygen supply to the lungs. This increase in airflow velocity causes the vibration of soft tissues that produces snoring.[1]

Symptoms:

The clinical features of obstructive sleep apnea are memory problems, excessive day time sleepiness, poor concentration, night drooling of saliva, depression, irritability, xerostomia, poor work performance, occupational accidents and a reduction in social interactions. OSA is associated with hypertension, ischemic heart disease, heart failure, cerebral ischemia, and cardiac arrhythmias.[5]

Investigations:

The procedures followed in diagnosing a patient with OSA are few but precise. These methods include a polysomnography test and a home sleep apnea test. Both of which are sleep studies, the most effective and accurate diagnostic tools.[2]

1. **Polysomnography:** This testing method is deemed as the gold standard examination to diagnose OSA.[6] The test involves overnight recording of sleep, breathing pattern, and oxygenation. The study records analysis of apnoea, oxygen saturation, body position, change heart rate, snoring, desaturation relations, and sleep staging.[1]
2. **Lateral cephalogram:** It is useful to analyse skeletal and soft tissue characteristics of patients with OSA and has the advantage of being available in most dental clinics, easy to perform and less expensive.[7]
3. **Magnetic resonance imaging:** Dynamic MR imaging can accurately diagnose the cause and level of upper airway narrowing in patients with OSA. It can characterize and anatomically classify the level of narrowing for planning reparative surgery.[8]
4. **Computed tomography:** CT scanning

and MRI significantly improves soft tissue contrast and allows precise measurements of cross-sectional areas at different levels, as well as three dimensional reconstruction and volumetric assessment. CT scanning has provided valuable insights into the pathophysiology of Sleep Disordered Breathing and plays a major role in its management.[5]

5. **Acoustic reflection test:** It provides an objective measurement of the nasal and pharyngeal cavities.[9] In this test, the sound wave is projected into the airway and is reflected back through the tube to a computer which creates graph that determines the location of the obstruction.[5]

Diagnosis:

The diagnosis must be made by a sleep physician. The role of the prosthodontist is to screen patients using the Epworth Sleepiness Scale, Stopbang and Berlin assessment tools and an oral examination and refer the patient to a sleep physician for diagnostic and treatment prescription when OSA is suspected.[4] Patient history regarding frequent awakenings, difficulty falling asleep, unrefreshing sleep, daytime sleepiness, mood disturbances, reduced motivation, morning headaches, excessive nocturia has to be taken[5] and proper physical examination has to be done.

Treatment:

Treatment of sleep-disordered breathing can be divided into following categories general categories. These include: (1) Lifestyle modification i.e. weight loss, cessation of alcohol consumption, sleep position training, (2) Positive airway pressure (CPAP), (3) Positional therapy, (4) Oral appliances and (5) Upper airway surgery.[2]

Lifestyle modification:

Patients with OSA and comorbid obesity should be counselled on long term weight management. A goal BMI < 25 kg/m2 through dietary or surgical weight loss may improve the AHI in obese patients with OSA.[10]

Positive Airway Pressure Treatment

a. **Continuous Positive Airway Pressure (CPAP):** The first line treatment for mild-severe OSA patients is CPAP. It had been discovered in 1983 by Dr. Sullivan. CPAP has constantly been demonstrating that it reduces the nocturnal obstructive events from the first night of the treatment.[11] "CPAP introduces a column of air that serves as a pneumatic splint for the upper airway preventing the airway from collapsing that is the physiological definition of the syndrome".[12] Due to the mechanism of CPAP, it has been proven that it eliminates snoring while sleeping. Therefore, CPAP is considered to improve quality of life by reducing OSA symptoms.[13] Individuals with pressure intolerance may experience dryness or irritation of nasal and pharyngeal membranes, nasal congestion or eye irritation from air leakage with CPAP use.

b. **Bilateral PAP:** It provides two different levels of pressure and can potentially treat OSA at a lower mean pressure than CPAP, at the same time improving lung ventilation via a pressure support. Bilateral PAP is a valid alternative in patients intolerant to CPAP.[14]

c. **Autotitrating CPAP:** It is a more sophisticated device providing an alternative to traditional CPAP. Auto CPAP continuously and automatically adjusts the delivered pressure in order to maintain upper airway patency following changes in airflow resistance. Compliance with Auto CPAP is slightly higher compared with fixed CPAP.[14]

Positional therapy:

PT, a device that prevents patients from lying

on their back, is considered as an alternative treatment for milder OSA patients. PT has many forms, such as the tennis ball technique. This technique consists of a small ball that is attached on the posterior part of the patients to obstruct sleeping on a supine position. Supine alarms and different positional pillows also improve the OSA symptoms respectfully. Although PT is effective and well tolerated in mild OSA cases, it remains an inferior treatment when compared to CPAP.[15]

Surgical options:

In 98.5% of adult patients with OSA results from abnormal anatomy of the upper airway and its supporting structures. Upper airway surgical approaches for the treatment of OSA fall into three categories:

(1) Classic procedures that directly enlarge the upper airway,

(2) Specilaized procedures that enlarge the upper airway by modifying soft tissue elements and/or the skeletal anatomy,

(3) Tracheotomy for control by means of bypassing the pharyngeal portion of the upper airway. Most procedures tend to address either the retropalatal or the retrolingual portion of the pharyngeal airway.[16]

Oral appliances:

Oral appliances were first referred to in 1923 in books by the French paediatrician Pierre Robin, who described the fall of the tongue base as a cause of nasopharyngeal impairment and suggested a prosthesis.[17] They were started using after describing a tongue retaining device to treat snoring and apnea by Cartwright and Samelson.[18] A renewed interest followed this device in mandibular development devices (MADs) that re-positioned the mandible in the protrusive position to help maintain the patency of the upper airway during sleep. The appliances can be broadly classified into the following types:

A. Tongue-retaining devices (TRD): TRDs incorporate an anterior hollow bulb, which generates a negative pressure vacuum when the tongue is inserted (fig 1). The tongue is held forward, away from the posterior

Figure 1: Tongue retaining devices

pharyngeal wall, opening up the airway. Owing to muscle anatomy, this appliance simultaneously modifies the position of the mandible. These devices are indicated for edentulous patients, and patients with potential temporomandibular joint problems. TRDs do not require retention from dentition, Minimal adjustments are required, Cause minimal sensitivity to teeth and TMJ.[1]

B. **Mandibular advancement devices (MAD):** It advances the mandible, brings forward the tongue and other muscles of the pharynx and elevates the palatoglossus muscle; thus, airway patency is enhanced. It also holds the mandible and other structures in a stable position to prevent the mouth opening. This is usually the most widely used respiratory device for apnea and has a higher evidence base. The devices cover the upper and lower arch and have metal hinges. The mandibular advancement device requires good retention, sufficient protrusion to maintain airway, minimal vertical opening, and full occlusal coverage.[1] Reduced effectiveness in patients with: TMJ, myofascial pain, tooth tenderness, excessive salivation, gum irritation and bleeding, dry mouth and edentulous patients. Long-term MAD use may lead to dental and skeletal side effects.[19]

1. **PM positioner:** This appliance links the upper and lower splints with bilateral orthodontic expanders. This appliance is made of thermoplastic material that must be heated in hot tap water every night before it is placed in the mouth.[20]
2. **Elastic mandibular advancement (EMA):** It is the thinnest and least bulky of all the appliances. It is similar to clear acrylic orthodontic retainers, and moves the jaw forward in fairly significant steps, and can be difficult to tolerate.5
3. **Klearway oral appliance:** The Klearway oral appliance uses a maxillary orthodontic expander to move the mandible forward sequentially. Klearway is a fully adjustable oral appliance used for snoring and mild to moderate OSA. A Small increase in mandibular advancement is initiated by the patient, preventing rapid jaw movements that cause significant patient discomfort.[21]

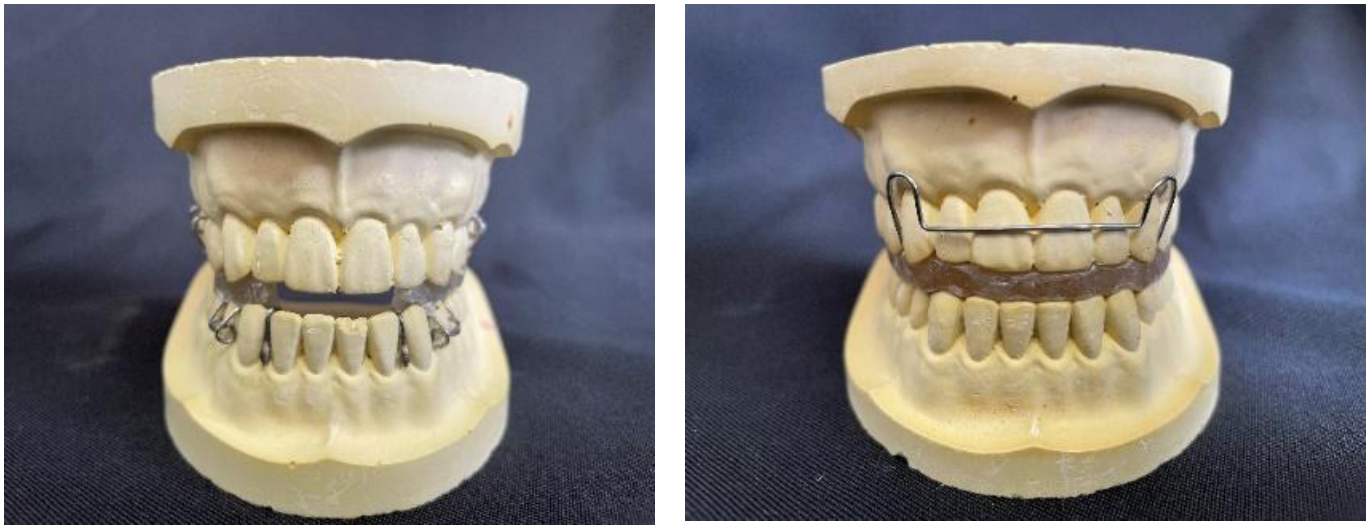

Figure 2: Twin block (left) and Monoblock (right) appliances

4. **The Thornton adjustable positioner (TAP):** This enables the progressive 0 mm advancements of the jaw through the anterior screw mechanism at the labial aspect of the upper splint. This appliance has a separate section for both the mandible and maxillary jaws.[22]

5. **Modified Herbst Appliance:** This design links upper and lower splints with a piston post and sleeve adjustable telescopic mechanism on each side. It prevents side to side motion, but since the mandible is held close with small orthodontic rubber bands, opening the jaws is fairly easy.[5]

6. **DUOBLOC:** It is a Custom-made adjustable mandibular advancement device (MAD) for the treatment of obstructive sleep apnea (OSA). This MAD has attachments in the frontal teeth area that allow for progressive advancement of the mandible.[5]

7. **The silencer system:** This incorporates titanium precision attachments at the incisor level, allowing sequential 2 mm advancement of up to 8 mm, lateral movement of 6 mm, (3 mm bilaterally) and vertical pin height replacements. It is the only appliance that enables anteroposteriorly adjustment and an open and closed position since it includes a very expensive titanium metal hinge device.[23,24]

Figure 3: Soft palate lift appliance

C. Soft palate lifting: The soft palate lifting prosthesis lifts and/or stabilizes the soft palate, preventing vibration during sleep (fig 3). The palatal lift prosthesis significantly improved the upper airway passage and eliminated snoring and airway obstruction, and improved the patient's overall quality of life.[25]

Conclusion:

Over the last decades, studies conducted on OSA have noted its prevalence and revealed its various risk factors, associated symptoms, successful diagnostic means, and effective therapy options.[2] Untreated sleep apnea is one of the major public health issues we face in common. Oral appliances play a crucial role in managing non-surgical OSA and have become the first line of treatment for almost all patients with OSA. The emergence of dental sleep medicine as a safe and effective treatment brings hope for the millions of patients looking for alternatives to CPAP treatment. Oral appliances used till date constitute a relatively heterogeneous group of devices for the treatment of sleep apnea and non-apneic snoring. Prosthodontists play a pivotal role in the initial diagnosis, management, and care of patients with sleep apnea.

References

1. Cheruku S, Duggineni CR, Harilal G, Lukka P. Obstructive sleep apnea: oral appliances and materials. Int J Dent Mater 2021;3(2): 58-63.
2. Johar RA et al.. Obstructive Sleep Apnea: A Review Article. Saudi J Oral Dent Res 2021;6(5): 221-226.
3. Nayar S and Knox J. Management of obstructive sleep apnea in an edentulous patient with a mandibular advancement splint: A clinical report. J Prosthet Dent 2005;94(2):108-111.
4. Wu JC and Dubois NMG. Role of Oral Devices in Managing Sleep-disordered Breathing Patients. ACP 2016;1-7.
5. Chandra SD, Raj KS, Prema et al. Obstructive sleep apnea and its prosthodontic management- an overview. Int J Health Sci Res. 2018; 8(3):259-265.
6. Maspero C, Giannini L, Galbiati G, Rosso G, & Farronato G. Obstructive sleep apnea syndrome: a literature review.

Minerva Stomatol 2015; 64(2):97-109.

7. Gungor AY, Turkkahraman H and Yariktas M. Cephalometric comparison of obstructive sleep apnea patients and healthy controls.Eur J Dent. 2013;7(1):48-54.
8. Bhawa, santhosham R, Anand S and Joseph S.Role of dynamic MR imaging in obstructive sleep apnea. Indian J Otolaryngol Head Neck Surg.2008;60(1):25-29.
9. Viviano JS. Acoustic reflection: Review and Clinical Applications for Sleep-Disordered Breathing. Sleep and Breathing. 2002;8(3).
10. Pavwoski P and Shelgikar AV. Treatment options for obstructive sleep panea. Neurol Clin Pract 2017;7(1):77-85.
11. Spicuzza L, Caruso D and Di Maria G. Obstructive sleep apnoea syndrome and its management. Therapeutic advances in chronic disease. 2015;6(5):273-285.
12. Weaver T. E, Calik M. W, Farabi S. S and Fink A. M et al. Innovative treatments for adults with obstructive sleep apnea. Nature and science of sleep. 2014;6.
13. Donovan L. M, Boeder, S Malhotra A and Patel S. R. New developments in the use of positive airway pressure for obstructive sleep apnea. Journal of thoracic disease.2015; 7(8).
14. Spicuzza L, Carusa D and Maria GD. Obstructive sleep apnea and its management. Adv Chronic Dis. 2015;6(5):273-285.
15. Weaver T. E, Calik M. W, Farabi S. S, and Fink A. M. Innovative treatments for adults with obstructive sleep apnea. Nature and science of sleep 2104;6:137.
16. Padma A, Ramakrishnan N and Narayanan V. Managemnt of obstructive sleep apne: A dental perspective. 2007;18(4):201-209.
17. Robin P. A fall of the base of the tongue considered as a new cause of nasopharyngeal respiratory impairment: Pierre Robin sequence, a translation. Plast Reconstr Surg 1994;93(6):1301-3.
18. Cartwright RD, Samelson CF. The effects of a nonsurgical treatment for obstructive sleep apnea: the tongue-retaining device. JAMA. 1982;248(6):705-9.
19. Doff MH, Finnema KJ, Hoekema A, et al. Long-term oral appliance therapy in obstructive sleep apnea syndrome: a controlled study on dental side effects. Clin Oral Investig 2013;17(2):475–82.
20. Giannasi LC, de Mattos LC, Magini M, Costa MS, de Oliveira CS, de Oliveira LV. The impact of the Adjustable PM Positioner appliance in the treatment of obstructive sleep apnoea. Archiv Med Sci. 2008;4 (3):336.
21. Lowe AA. Titratable oral appliances for the treatment of snoring and obstructive sleep apnea. J Can Dent Assoc 1999;65:571-4.
22. Thornton WK, Roberts DH. Nonsurgical management of the obstructive sleep apnea patient. J Oral Maxillofac Surg. 1996;54(9):1103-8.
23. Wade PS. Oral Appliance Therapy for Snoring and Sleep Apnea: Preliminary Report on 86 Patients with an Anterior Mandibular Positioning Device, The Silencer. Journal of Otolaryngology. 2003;32(2).
24. Schönhofer B, Stoohs RA, Rager H, Wenzel M, Wenzel G, Köhler D. A novel tongue advancement technique for obstructive sleep apnea and snoring: Side effects and efficacy. Am J Respir Crit Care Med. 1997;155:732-8.
25. Bhalla G, Arya D, Chand P, Singh K, Tripathi S. Management of obstructive sleep apnea with a palatal lift prosthesis. International Journal of Stomatology and Occlusion Medicine. 2013;6(3):101-5.