

OBSTRUCTIVE SLEEP APNEA SYNDROME

Abstract

Introduction: Obstructive sleep apnea syndrome is a significant illness affecting a large number of people. It is distinguished by disrupting normal sleep architecture by total or partial restriction of respiratory airflow. Airflow restriction causes a drop in blood oxygen saturation known as hypoxemia, which causes daytime somnolence. Individuals with excessive daytime somnolence have significantly lower productivity, decreased cognition, higher accident rates, and a variety of medical-dental diseases that affect all aspects of their lives.

It is well recognized that OSA is related with and can exacerbate a variety of medical conditions, including systemic hypertension, pulmonary hypertension, cardiac arrhythmia, ischemic heart disease, and stroke. This condition can be treated using a variety of conservative and surgical approaches.

Weight loss, sleep posture adjustments, intraoral device insertion, nasal continuous positive airway pressure (CPAP), and pharmacological therapy are all examples of conservative treatments. Surgical procedures include tracheostomy, uvulopalatopharyngoplasty, nasal septoplasty, and surgical mandibular advancement. Oral appliances for the treatment of snoring and OSA are divided into two types: those that hold the tongue forward and those that shift the jaw (and attached tongue) forward during sleep. Since the beginning of this century, oral appliances have been regarded as therapy alternatives for upper airway congestion caused by mandibular insufficiency. As it became clear that many devices were somewhat helpful in treating OSA, the producers of these devices sought FDA approval to commercialize these appliances for both OSA and snoring.

This chapter discusses obstructive sleep apnea, its pathogenesis, pathophysiology, clinical features, etiology, symptoms, and numerous treatment options, including prosthetic management, as well as the efficacy and complications of oral appliances.

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I. INTRODUCTION

Obstructive sleep apnea syndrome is a dangerous condition that affects many people. A complete or partial restriction of respiratory airflow disrupts the normal sleep architecture. Hypoxemia, or low blood oxygen saturation, is caused by restricted airflow. To reopen the airway, it stimulates arousal. These frequent arousals diminish sleep quality by altering sleep architecture. One of the defining aspects of this medical illness is excessive daytime somnolence caused by this cycle. Obstructive sleep apnea syndrome, if untreated, drastically reduces predicted life expectancy due to a number of connected comorbidities, including an increased risk of cardiovascular and pulmonary disease, as well as diabetes mellitus linked to obesity. Breathing issues caused by disrupted sleep are a rather common medical issue. It encompasses a wide range of respiratory abnormalities, from apnea to hypopnea. Obstructive apnea is characterized as a 10-second or greater pause in airflow during sleep, despite ongoing ventilatory effort. Hypopnea is defined as a temporary decrease in airflow of 30% to 50% lasting at least 10 seconds. The most well-known disorder in the group, obstructive sleep apnea (OSA), affects 2% to 4% of persons in their middle years.

Pathogenesis: OSA is defined by an obstruction of the upper airway, most commonly at the oropharynx level. Suffocation caused by apnea progresses until a brief rebound from sleep, when airway patency is restored and airflow resumes. The patient then goes back to sleep, and the same series of events is often repeated 400-500 times in a single night, resulting in significant sleep fragmentation.

The major mechanism causing upper airway collapse in OSA is the production of a crucial sub atmospheric pressure during inspiration that is greater than the airway dilator and abductor muscles' ability to maintain airway stability. Sleep has a permissive yet critical role in the sub atmospheric airway by lowering muscle activity.

Because of its selective lowering effect on the muscles of the upper airways and the alertness response that follows each apnea, alcohol is frequently a significant cofactor. Additionally, the majority of patients have physically compromised airway patency, which enhances the chance of tooth occlusion. Obesity frequently leads in smaller upper airways by increasing the amount of fat deposited in the pharynx's soft tissues or compressing it with superficial fat masses in the neck. Snoring may increase airway narrowing by producing edema in the soft tissues due to the high frequency vibration of the palate and pharyngeal soft tissues. Snoring is induced by the narrowing of the upper airway lumen. Snoring is induced by the narrowing of the upper airway lumen. Newer research indicates that greater airway compliance causes the airway to become "floppy" and prone to collapsing. A high upstream (i.e. nasal) resistance predisposes some patients to upper airway collapse by increasing the sub atmospheric pressure formed in the throat during inspiration when the diaphragmatic contraction force is raised to overcome nasal airflow resistance.

The most common disorders associated with central sleep apnea syndrome are congestive heart failure or illnesses of the central nervous system.⁵

II. ETIOLOGY

The respiratory disturbances associated with sleep vary by degree

1. **Apnea** : the cessation of airflow at the nose and mouth for 10 seconds or longer.

2. **Hypopnea** :

- Reduction in airflow at the nose and mouth.²In addition, apneas or hypopneas may vary by mechanism.
- Obstructive: The upper airway becomes more resistant.
- Central: Respiratory effort is reduced or ceases.
- Mixed: a period of central apnea followed by several obstructed breaths. These have the same clinical implications as purely obstructive events.

Sleep apnea (central or obstructive) is defined as an asymptomatic disorder, whereas sleep apnea syndrome (central or obstructive) is identified when symptoms arise.

Upper airway resistance syndrome is another newly identified and presumed to be a subgroup of OSA disease. The capacity of the upper airways reduces during this sickness, requiring more effort to breathe normally. The increased effort, similar to OSA syndrome, produces daytime sleepiness and frequent awakenings from sleep (referred to as respiratory effort-related arousal).

- The most common disorders associated with central sleep apnea syndrome are congestive heart failure or illnesses of the central nervous system.

Reduced upper airway diameter can be caused by any of the following:

Obesity (adipose tissue clumps have been observed near the airway)

- Adenotonsillar hypertrophy, which is more common in children.
- Mandibular deficiency, such as retrognathia or micrognathia, Macroglossia (frequently connected to hypothyroidism)
- Tumors of the upper airways (rare)
- Excessive pressure across the collapsible section, usually due to a clogged nose. The muscles that support the upper airway do not contract sufficiently to maintain its openness. Electromyographic studies revealed decreased electrical activity of these muscles during apneas, indicating a difficulty with respiratory regulation. The particular composition of this respiratory regulatory stability is unknown.

III. PROSTHETIC MANAGEMENT INTRAORAL APPLIANCES

As early as 1902, an oral appliance was proposed as a possible treatment for upper airway congestion and mandibular insufficiency.

Oral appliances of many different designs have been proposed and investigated in light of the growing interest in sleep apnea, and they are being used more frequently to treat

snoring and sleep apnea. This review's objective is to assess the data supporting these devices' efficacy. A device placed in the mouth to change the posture of the mandible, the tongue, and the tissues in the upper airway in order to treat snoring or sleep apnea is referred to as a "oral appliance" in general. Although many of these gadgets employ traditional dental technology and attach to the teeth, we use the more broad phrase to refer to gadgets that are used intraorally but may not always be kept by the teeth. Obstructive sleep apnea has been treated using a variety of technologies. Both those that advance the tongue and those that advance the mandible can be categorized into the two main categories.

One of the earliest appliances created was the tongue retention device (TRD). It is a specially constructed device with a front bulb that can fit on both the maxillary and mandibular dental arches. The anterior compartment's suction holds the tongue in a forward posture. The appliance is held in place by a flange that fits between the lips and the teeth.

The device and the tongue are held forward in the oral cavity by a flange that fits between the lips and the teeth. There have been studies on a number of mandibular positioning devices. There are currently devices with a thermal labile material available, despite the fact that the majority still need dental impressions, bite registration, and manufacturing by a dental laboratory.

IV. RATIONALE FOR THE USE OF MANDIBULAR ADVANCEMENT SPLINTS (MAS)

The use of dental devices to relieve upper airway congestion was noted as early as 1902. Many cephalometric studies utilizing MASs have indicated that awake people have wider upper airways. When examining airway responses to MAS, it is critical to note the limitations of a 2-dimensional picture that only displays antero-posterior alterations. However, there is a scarcity of data on the impacts of MAS in the transverse plane. The use of an oral appliance induces a change in the morphology of the airway as well as an increase in airway space, according to computer tomography. Ryan et al. recently described an increase in the cross-sectional area of the upper airway, notably in the velopharynx, when a MAS was worn, utilizing video fluoroscopy.

Gale et al. explored the use of low dose computed tomography to see the 3-dimensional alterations in the airway after the implantation of an anterior mandibular positioning appliance (AMPA). The authors were able to demonstrate that the administration of an AMPA raised the minimum pharyngeal cross-sectional area, but they were unable to link this to patient response to symptom alleviation due to the substantial but unpredictable variations detected. Despite the significant variation in MAS design, clinical effects appear to be rather consistent, since OSA improves in the majority of people. According to the results of the American Sleep Disorders Association's examination of twenty-one articles, the mean apnoea hypopnea index (AHI) appeared to decrease from 47 to 19. Despite the authors' meticulous evaluation of all published data on the use of intra-oral devices for the treatment of OSA, the review has a number of limitations. It had a small sample size and was entirely comprised of case studies. There were only a few randomized controlled trials. All of the patient descriptions, study procedures, and selection criteria were inconsistent and deficient. A small number of superbly constructed prospective randomised studies have lately been detailed in the literature.

Two of these studies looked at the efficacy of nasal CPAP with a mandibular advancement splint (MAS) 118, 119, and discovered that the MAS had a considerable influence (45% reduction in AHI score), but was less efficient than n-CPAP (70% reduction in AHI score).

Despite having the same compliance rate, the MAS was considerably superior to n-CPAP. In Bloch et al 120's evaluation of the effects of two alternative MAS designs, the AHI was reported to have fallen from 22.6 (no treatment intervention) to 8.7 (two-piece appliance) and 7.9 (single-piece appliance). Tegelberg et al. 121 examined the effects of MAS therapy and oropharynx surgery in a prospective randomized study. 95% of the patients who finished the study did so by lowering their AHI by 50% or more, according to the investigators. This compared favorably with the outcomes of their study's surgical aspect.

V. MECHANISM OF ACTION

The purpose of any oral appliance for snoring or OSA treatment is to expand the airway or, at the very least, reduce collapsibility between the soft palate and the posterior pharyngeal wall. The three general types of devices are explored more below.

- 1. Device Categories Devices for mandibular placement (advancing)-** The goal of attaching to one or both dental arches is to advance or rotate the jaw downward. To fit precisely, the bulk of devices must be custom-made for each user. A competent dental laboratory creates the custom-made gadget using the impressions. These are the most well-known and helpful devices. The thermal malleable device from one company is intended to be molded and installed in an office. Devices for keeping the tongue in place: By providing negative pressure on a soft plastic bulb, this design holds the tongue anteriorly as you sleep. Despite the fact that this is an intriguing concept, few patients adopt these devices for apparent reasons of comfort and compliance.
- 2. Palatal lifting devices:** The Sleep Disorders Dental Society does not suggest these devices since they have not been shown to be effective in reducing snoring or OSA.

Snore Guard is a boil and bite device that fits comfortably directly on the patient, is easily adjustable, and appears to be well tolerated. The mandible has a 7 mm aperture and is positioned 3 mm behind the maximum projection. The device covers only the anterior teeth and features a soft polyvinyl liner for the patient's comfort. The FDA has cleared the Snore Guard for sale only for the purpose of treating snoring. Schmidt-Nowara discovered that after 7 months of use, 75% of the 68 patients continued to use the device frequently.

Snoring was reduced in all but one person, and it was eliminated in 29 Polysomnography revealed a reduction in RDI from 47.4 to 19.7 in 20 OSA patients. Sleep disturbance and oxygenation were also reduced. Ferguson et al. studied the efficacy, side effects, patient compliance, and preference of Snore Guard and nCPAP therapy in a randomized, prospective, crossover study of individuals with mild-to-moderate OSA for 4 months. With nCPAP, the RDI was lower than with oral appliances. 48% of Snore Guard users reported successful treatments (RDI reduction to 10 per hour

and symptom alleviation), 24% had compliance challenges, and 28% had treatment complications. Four people refused to use nCPAP after utilizing the Snore Guard.

38% of nCPAP users experienced compliance challenges, while 62% of patients saw overall treatment success and no patients experienced treatment failure. Patients reported reduced satisfaction with nCPAP and more negative effects. Both therapy were effective for seven individuals; six of these patients chose Snore Guard as a long-term treatment, while one preferred nCPAP. Some people with mild-to-moderate OSA benefit from the Snore Guard, which has fewer side effects and a greater patient satisfaction rate than nCPAP. The Snore Guard has the advantage of being fairly priced and needing less clinical time from the dentist, but it is not adjustable, may place too much pressure on certain patients' lower anterior teeth, and may cause retention concerns.

- 3. TheraSnore:** Therasnore is a marketable adjustable bite device that has only received FDA market approval for the treatment of snoring. The appliance's upper and lower trays click together utilizing four locking mechanisms. A more robust polycarbonate frame surrounds two thermoplastic trays made of the same material.

The TheraSnore can be adjusted forward or backward in 1.5-mm increments. The lower tray prevents the tongue and jaw from falling back when sleeping, while the upper tray is designed to fit over the maxilla. The appliance is set to the patient's central occlusion, and the appliance's position indicators can be utilized to advance the mandible.

Schmidt-Nowara et al. used MRI to demonstrate that wearing a Snore Guard or utilizing TheraSnore expanded the retropalatal and retroglossal spaces in 13 OSA patients. Schwab et al.¹⁴⁷ examined the same patient sample and discovered that a decrease in lateral pharyngeal wall thickness was associated with an increase in cross-sectional area. According to Miyazaki et al.¹⁴⁸'s¹⁴⁸ evaluation of the TheraSnore in 11 OSA patients, 40% experienced a rise in their lowest oxygen saturation level of more than 10%, and 70% experienced an increase of more than 5%. The average RDI fell from 49.5 to 32.0, and 60% of patients reported improvement in subjective symptoms. Tongue Retaining Device (TRD). The TRD is a specially constructed appliance with an anterior bulb that holds the tongue forward as you sleep through the use of negative pressure. A modified TRD with lateral airway tubes is also available for individuals with blocked nasal passages, enabling mouth breathing. The TRD has been given FDA marketing authorization for the treatment of snoring. Patients with big tongues benefited from the TRD appliance in particular. In individuals with a deficient dentition or who are edentulous, it is a successful substitute for a mandibular repositioner. The only device that has been examined in a variety of body postures and in conjunction with other types of therapy is the TRD. After inserting the TRD, the mean AI decreased from 54.4 to 22.7 in a study by Cartwright and Samelson ¹⁴⁹ evaluating 14 individuals. Also, shorter and much fewer apneic fits along with improved quality of sleep were observed. As soon as the treatment started, the sleep architecture shifted toward a more normal pattern, with less light sleep and more 6-wave and REM sleep. The results seen were comparable to the rate reported by patients who had either undergone uvulopalatopharyngoplasty (UPPP) or a tracheotomy for therapy. In a group of 16 male patients, those who experienced a significant worsening of the AI when dozing supine were more responsive to the TRD

than those who experienced the same degree of impairment in both the lateral and supine positions.

On their backs as opposed to their sides, the AI in untreated subjects was twice as high. In a discriminant function analysis, obesity, age, and position ratio all effectively predicted TRD success (defined as an AI 6 or a 50% drop in AI) for 81% of the patients. 30 male patients made up the sample. At one year, 65% of people who had been using the TRD either on its own or in conjunction with other therapies had improved. As reported by Samelson, the TRD had an impact on 80% of patients after using it for three years or more. In another TRD report, a group of 12 subjects were treated with the TRD alone or in conjunction with some A set of 12 participants were given the TRD either alone or in conjunction with behavioral therapy, such as sleep position training [60] or weight loss, in a different TRD report. In this first group, a mean RDI decline from 37.0 to 17.3 was seen in another group of patients with more severe apnea, the TRD was paired with a submucous septal excision or a UPPP. In a separate study¹⁵⁰, 60 adult males with RDI values greater than 12.5 and twice or more the supine sleep apnea rate compared to their lateral sleep rate were randomly assigned to one of four treatment groups: TRD alone, TRD + posture alarm, or health habit training. Approximately 80% of the TRD plus posture alarm group improved, while 73% of the TRD group did not. The mean RDI for the 15 people who only received the TRD was reduced from 27.4 to 11.4. The patency of the nasal airway and an initially low side index were two characteristics strongly related with good OSA control with the TRD. Lower initial obesity and greater weight loss after treatment were the factors associated with the greatest success for the 15 patients in the TRD plus posture alarm group. In the latter group, the mean RDI dropped from 30.7 to 7.9. TRD has been studied to see how it affects the normal activity of the tongue muscles. Ono et al. ¹⁵¹ discovered that the awake genioglossus muscle activity is affected differently by the TRD in control subjects and OSA patients. The TRD decreases genioglossus muscle activity in OSA patients who are awake and corrects the delayed timing of the muscle before to an apneic episode. The TRD may be able to offset genioglossus muscle variations and exhaustion in the muscles of the tongue. A pneumatic splint similar to one used with nCPAP may also be provided by the TRD to expand the upper airway.

VI. OVERVIEW

Patients who cannot tolerate nCPAP or who are at high surgical risk may benefit from oral appliance therapy for snoring, OSA, or both since it is simple to use, reversible, quiet, and inexpensive. Oral appliances appear to be effective when there is variable airway space, a constant anterior position of the jaw, advancement of the tongue or soft palate, and possibly a shift in genioglossus muscle activity.

In order to prevent long-term vertical alterations to the dentition, they should have full occlusal covering. The attending physician must always decide which patients are appropriate for oral appliance therapy. The dentist will then select the appropriate mouth appliance.

If such an examination is available, it is important to document the impediment's location. Traditional cephalometry may reliably estimate tongue, soft palate, and nasopharynx volume, but it cannot predict oropharynx or hypopharynx size. If CT or MRI

scans reveal a restricted oropharynx, any device that can widen the airway by moving the tongue alone or the mandible and the tongue together may be useful. A TRD may be useful if the patient's tongue appears to be overly large, if the patient has no teeth, or if the patient's dental health is poor. When combined with behavioral changes, the TRD becomes substantially stronger.

Mandibular Repositioners: All of them work to alter the airway tube's three-dimensional size. By moving the mandible forward, holding the tongue forward, or altering the vertical dimension, oral appliances can influence the baseline activity of the tongue muscle. There have been a number of potential contraindications for using oral appliances, however not all of them apply to every gadget. They should, of course, only be used to treat obstructive sleep apnea, which is measured by nocturnal polysomnograms. If oral appliances just move the jaw downward and backward when a predisposing hypopharyngeal constriction is present, OSA may become worse. Patients who have arthritis, crepitus, or other severe temporomandibular joint concerns do not tolerate oral appliances well; nevertheless, the forward-biting position may help with moderate joint issues. For the majority of appliances, there have to be enough healthy teeth to anchor the oral appliance. In some people, allergies and nasal blockages may also be contraindications. Finally, only cooperative patients who are motivated to wear the appliance during sleep on a regular basis can be treated using oral appliances. Further research is needed on a number of issues. How can the obstruction site be quickly and affordably located? Who is a good candidate for an oral appliance? Which device will be the most useful for every given patient? How well do these appliances function over the long term? Are the temporomandibular joint or teeth affected negatively over the long term? There is unquestionably a need for a lengthy prospective research of the frequency and magnitude of occlusal alterations. Minor tooth position changes can be corrected using a variety of straightforward techniques, but these patients must be closely monitored over time. The effectiveness of oral appliances for the treatment of snoring or OSA is already established, and patients now want alternatives to surgery and nCPAP.

Three comparisons of oral appliances and nCPAP have been conducted, and it has been established that oral appliances have significant patient preference and efficacy. Oral appliances have also been shown to help patients whose uvulopalatopharyngoplasty treatments have failed. Several patients with snoring or mild-to-moderate OSA can be successfully treated with oral appliances provided the initial evaluation is coordinated by the attending physician and good communication is established with the dentist involved.

To sufficiently cure the material before it separates from the articulator, direct the light source to both the buccal and lingual surfaces.¹⁰ Take the prosthesis out of the molds, finish it, and place it in the Triad unit for final curing.¹¹ Use the pressure-indicating paste therapeutically to show potential sources as needed. Give the patient information on how to insert and remove the prosthesis correctly. Give instructions on how to care for the prosthesis at home. To avoid or mitigate the detrimental effects of continuous wear, complete dentures should be removed at a specific time during the day.¹² Rate the patient's sleep quality and look for the appearance of hypersomnolence and other related symptoms during the subsequent evaluation. There should be no myofascial or temporomandibular joint symptoms in the patient, and the prosthesis should be stable and held throughout the night. If discomfort emerges, the prosthesis may be separated, and the vertical dimension may be reduced.

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