

DIAGNOSIS AND MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA

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Abstract

Collapsibility of the upper airway in obstructive sleep apnea (OSA) causes repeated arousals from sleep, decreased oxygen saturation of the blood, and excessive sleepiness. Patients with OSA are at increased risk of cardiovascular and cerebrovascular disease, and experience occupational and vehicular accidents more frequently than the general population.

Nasal continuous positive airway pressure (CPAP) is the current treatment of choice, but its cumbersome nature makes tolerance and compliance less than optimal. There is growing interest in the use of oral appliances to treat snoring and OSA.

The rationale is that advancement of the mandible and tongue impacts positively on upper airway caliber and function.

There are many such types of appliances, and they have potential advantages over CPAP in that they are unobtrusive, make no noise, do not need a power source, and are potentially less costly. There is a growing evidence base to support the use of oral appliances in the management of OSA.

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Introduction

Obstructive sleep apnea (OSA) is a disorder in which a person stops breathing during the night, perhaps hundreds of times. These gaps in breathing are called *apneas*. The word apnea means absence of breath. An obstructive apnea episode is defined as the absence of airflow for at least 10 seconds. Sleep apnea is usually accompanied by snoring, disturbed sleep, and daytime sleepiness. People might not even know they have the condition.

Obstructive Sleep Apnea:

Obstructive sleep apnea (OSA) occurs when tissues in the upper throat collapse at

different times during sleep, thereby blocking the passage of air. In general, OSA occurs as follows:

- On its way to the lungs, air passes through the nose, mouth, and throat (the upper airway).
- Under normal conditions, the back of the throat is soft and tends to collapse inward as a person breathes.
- Dilator (widening) muscles work against this collapse to keep the airway open. Interference or abnormalities in this process cause air turbulence.
- If the tissues at the back of the throat collapse and become momentarily blocked, *apnea* occurs. Breath is temporarily stopped. In most cases the person is unaware of it, although sometimes they awaken and gasp for breath.
- In some cases, the interference is incomplete (called obstructive *hypopnea*) and causes continuous but slow and shallow breathing. In response, the throat vibrates and makes the sound of snoring. Snoring can occur whether a person breathes through the mouth or the nose. (Snoring often occurs without sleep apnea.)

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- Apnea decreases the amount of oxygen in the blood, and eventually this lack of oxygen triggers the lungs to suck in air.
- At this point, the patient may make a gasping or snorting sound but does not usually fully wake up.

Obstructive sleep apnea is defined as five or more episodes of apnea or hypopnea per hour of sleep (called apnea-hypopnea index or AHI) in individuals who have excessive daytime sleepiness. Patients with 15 or more episodes of apnea or hypopnea per hour of sleep are considered to have moderate- sleep apnea.

Causes:

General Causes of Obstructive Sleep Apnea

Structural abnormalities in the face, skull, or airways that cause some obstruction or collapse in the upper airways and reduce air pressure can produce sleep apnea syndrome. People with micrognathia, retrognathia, enlarged tonsils, tongue enlargement, and acromegaly are especially predisposed to obstructive sleep apnea. Abnormalities or weakness in the muscles that surround the airway can also contribute to obstructive sleep apnea.

Problems with the soft palate (the soft tissue at the back of the roof of the mouth) are also associated with many cases of sleep apnea. Obesity can contribute to sleep apnea when fat deposits clog throat tissue.

Risk Factors:

Gender

Sleep apnea is more common in men than in women. Men tend to have larger necks and weigh more than women. However, women tend to gain weight and develop larger necks after menopause, which increases their risk of developing sleep apnea.

Age

Sleep apnea is most common in adults ages 40 - 60 years old. Middle age is also when symptoms are worse. Nevertheless, sleep apnea affects people of all ages.

Race and Ethnicity

African-Americans face a higher risk for sleep apnea than any other ethnic group in the

United States. Other groups at increased risk include Pacific Islanders and Mexicans.

Family History

People with a family history of obstructive sleep apnea are at increased risk of developing the condition.

Obesity

Obesity, especially having fat around the abdomen (the so-called apple shape), is a particular risk factor for sleep apnea, even in adolescents and children. However, not all people who are obese have sleep apnea. Specific anatomical and physiological properties in the airways are more likely to be present in obese individuals with apnea.

Physical Characteristics

Large Neck. A large neck (17 inches or greater in men and 16 inches or greater in women) is a risk factor for sleep apnea.

Facial and Skull Characteristics. Structural abnormalities in the face and skull contribute to many cases of sleep apnea. These include:

- A long lower part of the face
- Brachycephaly, a birth defect in which the head tends to be shorter and wider than average
- A narrow upper jaw
- A receding chin
- An overbite
- A larger tongue

Soft Palate Characteristics. Some people have specific abnormalities in the soft area (palate) at the back of the mouth and throat that may lead to sleep apnea. These abnormalities include:

- The soft palate is stiffer, larger than normal, or both. An enlarged soft palate may be a significant risk factor for sleep apnea.
- The soft palate and the walls of the throat around it collapse easily.

Symptoms:

People with sleep apnea usually do not remember waking during the night.

Symptoms may include:

- *Excessive daytime sleepiness.* Generally,

patients risk falling asleep during the day while performing routine activities such as reading, watching TV, sitting inactively, lying down, or riding in a car while a passenger or stopped for a few minutes in traffic. Usually, these brief episodes of sleep do not seem to relieve their overall sense of sleepiness.

- *Morning headaches.*
- *Irritability and impaired mental or emotional functioning.* These types of symptoms are directly related to interrupted sleep.
- *Snoring.* Bed partners may report very loud and interrupted snoring. Patients experience snoring associated with choking or gasps. This often occurs in a crescendo pattern with the loudest noises occurring at the very end. These findings are more likely to occur when lying down (supine position). Patients often suffer from frequent arousals during sleep because of snoring.

Diagnosis:

The symptoms of obstructive sleep apnea are not very specific. This means that many people who snore at night or who feel tired during the day probably do not have sleep apnea. Other medical reasons for daytime sleepiness should be considered by your doctor before referral to a sleep center for diagnostic sleep tests.

They include:

- Having to work excessive hours or varying shifts (nights, weekends)
- Medications (tranquilizers, sleeping pills, antihistamines beta blockers, many others)
- Alcohol abuse
- Medical conditions (such as hypothyroidism, hypercalcemia, and hyponatremia / hypernatremia)
- Self-imposed short sleep time
- Other sleep disorders, such as narcolepsy, insomnia, or restless legs syndrome
- Chronic fatigue syndrome
- Depression

Symptoms or findings that make the need for evaluation by a sleep specialist include:

- Sleepiness is affecting patient's quality of life
- Sleepiness on-the-job places the patient or others in danger
- Others have observed apnea or breath holding spells while asleep

- Other medical illnesses that may be worsened by obstructive sleep apnea are present.

If symptoms suggest obstructive sleep apnea or other sleep disorders, further diagnostic testing will be performed. A sleep specialist or sleep disorders center will perform an in-depth medical and sleep history and physical exam.

Keeping a Record of Sleep. To help answer these questions, the patient may need to keep a sleep diary. Every day for 2 weeks, the patient should record all sleep-related information, including responses to questions listed above described on a daily basis. Recording sleep behavior using an extended-play audio or videotape can be very helpful in diagnosing sleep apnea.

Physical Examination

To diagnose sleep apnea, the doctor will check for physical indications of sleep apnea, including:

- Abnormalities in the soft palate or upper airways, including enlarged tonsils
- Upper body obesity
- A wide neck measurement

Polysomnography and Home Sleep Studies

Polysomnography is the technical term for an overnight sleep study that involves recording brain waves and other sleep-related activity. Polysomnography involves many measurements and is typically performed at a sleep center.

Home Diagnostic Portable Devices

A number of portable devices are available, or being developed, so that patients have the convenience of being monitored at home. Devices that can accurately diagnose sleep apnea and titrate CPAP may eventually replace the need for many overnight sleep studies or the need for attended monitoring at home. These home devices can be very different from each other. Some are able to measure all the different factors that a sleep study performed at a sleep center is able to measure. Others are only able to measure some of them and may not get the full picture or accurate diagnosis.

Unattended Monitoring with Auto-CPAP. This Home monitoring method is a recent and simple technique for detecting impaired breathing. It

uses an auto-CPAP machine, which is programmed to apply pressure through the airways via a tube that attaches to a mask that fits the nose. A monitor is attached that digitizes and records on a computer all the information on any apnea episodes during sleep.

Treatment:

Treatment for sleep apnea depends on the severity of the problem. Given the data on the long-term complications of sleep apnea, it is important for patients to treat the problem as they would any chronic disease. Simply trying to treat snoring will not treat sleep apnea. Because of its association with heart problems and stroke, sleep apnea that does not respond to lifestyle measures should be treated by a doctor, ideally a sleep disorders specialist.

At this time, the most effective treatments for sleep apnea are devices that deliver slightly pressurized air to keep the throat open during the night. There are a number of such devices available.

Continuous Positive Airflow Pressure (CPAP)

The best treatment for symptomatic obstructive sleep apnea is a system known as continuous positive airflow pressure (CPAP), sometimes referred to as nasal continuous positive airflow pressure (nCPAP). It is safe and effective in sleep apnea patients of all ages, including children.

CPAP may not be recommended for patients who have mild-sleep apnea as identified in sleep studies but who do not have daytime sleepiness, as they generally report little or no benefit from this treatment. Those with more moderate sleep apnea are more likely to receive a trial of CPAP, but not always. When severe sleep apnea is present, most patients will receive CPAP. Overall, CPAP is considered first-line treatment for mild-to-moderate, or severe obstructive sleep apnea. CPAP works in the following way:

- The device itself is a machine weighing about 5 pounds that fits on a bedside table.
- A mask containing a tube connects to the device and fits over just the nose.
- The machine supplies a steady stream of air through a tube and applies sufficient air pressure to prevent the tissues from collapsing during sleep.

Effects on Sleep and Wakefulness. CPAP improves both objective and subjective measures of sleep. After using CPAP regularly many patients report the following benefits:

- Restoration of normal sleep patterns.
- Greater alertness and less daytime sleepiness.
- Less anxiety and depression and better mood.
- Improvements in work productivity.
- Better concentration and memory.
- Patients' bed partners also report improvement in their own sleep when their mates use CPAP, even though objective sleep tests showed no real difference in the partners' sleep quality.

If patients comply with the CPAP regimen but do not feel less sleepy after a period of time, or their sleep apnea symptoms do not improve, the airflow pressure may not be high enough. Patients may need to be retested. Likewise, if patients have started using an oral appliance or had a surgical procedure, their doctor probably needs to reevaluate them.

Surgery:

Surgery is sometimes recommended, usually by ear, nose, and throat specialists, for severe obstructive sleep apnea. A patient should be sure to seek a second opinion from a specialist in sleep disorders. Few randomized clinical trials, the gold standard of medical research, have been conducted to verify the long-term efficacy of sleep apnea surgery.

Uvulopalatopharyngoplasty (UPPP)

The Procedure.

Surgery known as uvulopalatopharyngoplasty (UPPP) removes soft tissue on the back of the throat. Such tissue includes all or part of the uvula (the soft flap of tissue that hangs down at the back of the mouth) and parts of the soft palate and the throat tissue behind it. If tonsils and adenoids are present, they are removed. The surgery typically requires a stay in the hospital.

The Goal of Surgery. The goal of UPPP is threefold:

- Increase the width of the airway at the throat's opening
- Block some of the muscle action in order to improve the ability of the airway to remain open

- Improve the movement and closure of the soft palate.

Success Rates.

Success rates for sleep apnea surgery are rarely higher than 65% and often deteriorate with time, averaging about 50% or less over the long term. Few studies have been conducted on which patients make the best candidates. Some studies suggest that surgery is best suited for patients with abnormalities in the soft palate. Results are poor if the problems involve other areas or the full palate. In such cases, CPAP is superior and should always be tried first. Many or most patients with moderate or severe sleep apnea will likely still require CPAP treatment after surgery.

Laser-Assisted Uvulopalatoplasty (LAUP)

A variation on UPPP called laser-assisted uvulopalatoplasty (LAUP) is being increasingly performed to reduce snoring. It removes less tissue at the back of the throat than UPPP and can be done in a doctor's office. At this time, however, long-term success rates in the treatment of obstructive sleep apnea with LAUP are very modest, particularly for reducing apneas. Some doctors, in fact, are concerned that if LAUP eliminates snoring, they may miss a diagnosis of apnea in patients who have the more serious condition.

More than 50% of patients complain of throat dryness after surgery. Throat narrowing and scarring have also been reported. In a minority of patients, snoring becomes worse afterward.

Pillar Palatal Implant

The pillar palatal implant is a noninvasive surgical treatment for mild-to-moderate sleep apnea and snoring. However, the main focus of the procedure is a reduction in snoring. The implant helps reduce the vibration and movement of the soft palate.

In this procedure, a doctor inserts 3 short pieces of polyester string into the soft palate. The procedure can be performed in a doctor's office and takes about 10 minutes. Unlike uvulopalatopharyngoplasty (UPPP), the pillar procedure requires only local anesthesia. Studies indicate it works as well as UPPP, with less pain and quicker recovery time.

Other Procedures

Other surgical procedures may be appropriate to correct facial abnormalities or obstructions that cause sleep apnea. They may be used alone or combined with each other or with UPPP. Most are invasive and reserved for patients with severe sleep apnea who fail to respond to or comply with CPAP. They include:

- Genioglossus (tongue advancement), in which an opening is cut where the tongue joins the jawbone and the area is pulled forward.
- Temperature controlled radiofrequency ablation tongue reduction.
- Genioplasty, which is plastic surgery on the chin.
- Hyoid advancement surgery, in which the movable bone underneath the chin is moved forward, pulling the tongue muscle along with it.
- Maxillary or maxillomandibular advancement (MMA), which moves the upper (maxilla) or lower (mandible) jawbone forward. A survey of patients who had MMA found that the surgery changed their facial appearance, but most people thought it was a change for the better.

Surgery for nasal obstructions (such as a deviated septum) that contribute to snoring and other symptoms.

Dental Devices

The American Academy of Sleep Medicine recommends dental devices for patients with mild-to-moderate obstructive sleep apnea who are not appropriate candidates for CPAP or who have not been helped by it. (CPAP should be used for patients with severe sleep apnea whenever possible.)

Pretreatment dental assessment

This includes dental history and an oral examination focusing on parafunctional habits, wear facets and temporomandibular joint (TMJ) status have to be recorded prior to treatment planning.

Oral appliances are worn only during sleep and work to enlarge the airway by moving the tongue (anteriorly) or the mandible to enlarge the airway. Whether they change the airway shape or increase the cross-sectional area of the upper airway is not clear. It is hypothesized that these appliances may also affect upper airway muscle

tone and thus decrease their collapsibility. Movement of the tongue or mandible anteriorly can increase the cross-sectional size of the airway¹ and hence oral appliances help in increasing the airway size.² Activation of the upper airway dilator muscles by the appliance could cause a decrease in airway collapsibility and this may contribute to preservation of airway patency during sleep,³ although the increase in airway size may be the most important factor preventing airway occlusion.

A tongue-retaining device is a custom-made soft acrylic appliance that covers the upper and lower teeth and has an anterior plastic bulb. It uses negative suction pressure to hold the tongue in a forward position inside the bulb.

By holding the tongue in a forward direction through its attachment to the genial tubercle, it stabilizes the mandible and hyoid bone, thus preventing retrolapse of the tongue. These devices, reverse pharyngeal obstruction both at the level of the oropharynx and the hypopharynx, thereby enlarging the airway and reducing snoring and the related apnea.⁴ Soft palate trainers and tongue posture trainers are rarely used.⁵

Oral devices are basically acrylic custom made devices to,

- a. Reposition and recondition the mandible. e.g., Herbst appliance⁶ / snoreguard⁷ / silencer.⁸ They function by engaging one or both of the dental arches to modify mandibular protrusion
- b. Tongue repositioning or retaining devices, e.g., SnorEx.⁹
- c. Soft-palate lifters.⁵
- d. Tongue trainers.⁵
- e. A combination of oral appliance and CPAP in the new products deliver pressurized air directly into the oral cavity and eliminates the use of head gear or nasal mask and avoids the problems of air leaks and the claustrophobia associated with CPAP treatment.¹⁰

Patients fitted with one of these devices should have a check-up early on to see if it is working; short-term success usually predicts long-term benefits. It may need to be adjusted or replaced periodically.

Benefits of Dental Devices. Dental devices seem to offer the following benefits:

- Significant reduction in apneas for those with mild-to-moderate apnea, particularly if patients sleep either on their backs or stomachs. They do not work as well if patients lie on their side. The devices may also improve airflow for some patients with severe apnea.
- Improvement in sleep in many patients.
- Improvement and reduction in the frequency of snoring and loudness of snoring in most (but not all) patients.
- Higher compliance rates than with CPAP.

Dental devices have shown better long-term control of sleep apnea when compared to uvulopalatopharyngoplasty (UPPP), the standard surgical treatment. There are also few complications with a dental device.

Disadvantages of Dental Devices. Dental devices are not as effective as CPAP therapy. The cost of these devices tends to be high. Side effects associated with dental devices include:

- Nighttime pain, dry lips, tooth discomfort, and excessive salivation. In general, these side effects are mild, although over the long term they cause nearly half of patients to stop using dental devices. Devices made of softer materials may produce fewer side effects.
- Permanent changes in the position of the teeth or jaw have occurred in some cases of long-term use. Patients should have regular visits with a health professional to check the devices and make adjustments.

In a small percentage of patients, the treatment may worsen apnea.

Orthodontic Treatments

An orthodontic treatment called rapid maxillary expansion, in which a screw device is temporarily applied to the upper teeth and tightened regularly, may help patients with sleep apnea and a narrow upper jaw. This nonsurgical procedure helps to reduce nasal pressure and improve breathing.

Declaration of Interest

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