

Sleep-Disordered Breathing

A Peer-Reviewed Publication
Written by Steven R. Olmos, D.D.S.

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Educational Objectives

1. Know the types of sleep-disordered breathing, signs and symptoms
2. Know how to screen patients for OSA
3. Know the different appliance options available; their purpose, advantages and disadvantages

Introduction

About 70 million Americans suffer from a sleep problem; among them, nearly 60% have a chronic disorder.¹ Snoring is the mildest form of sleep-disordered breathing (SDB) and obstructive sleep apnea is the most severe. Research has found that around 40% of adults snore. SDB is also recognized to affect approximately 1% – 3% of children.² Around 4% of women and 9% of men show evidence of sleep apnea. The National Institute of Health considers OSA a common disorder, affecting 12 million Americans. Despite this widespread prevalence, most cases remain undiagnosed and untreated; 93% of middle-aged women and 82% of middle-aged men with moderate to severe OSA have not been clinically diagnosed.³

Snoring and Sleep Apnea

Sleep apnea can be central, obstructive, or mixed. *Central sleep apnea* occurs when airflow stops as a result of a temporary lack of inspiration (such as occurs with poliomyelitis, spinal cord injury, encephalitis). *Obstructive sleep apnea* is a complete cessation of breathing during sleep for at least ten seconds. This is due to an obstruction that can be oropharyngeal, nasopharyngeal or hypopharyngeal in origin. Examples of obstructions include swollen adenoids and tonsils, a small airway (anatomical as opposed to pathological in origin), malocclusion, as well as sinus problems and allergies that cause swelling of the nasal mucous membranes. A person is considered to be suffering from sleep apnea if they have 30 or more episodes of cessation of breathing during 7 hours of sleep.⁴ Sleep apnea may be mild (5 – 15 episodes per hour), moderate (15-25 episodes per hour), or severe (30 or more episodes per hour).

Patent airway



Obstructed airway



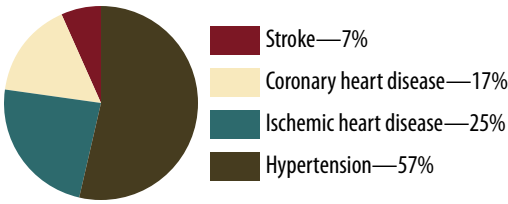
Mixed apnea is a combination of both central and obstructive sleep apneas, with the central apnea usually occurring first and being followed by obstructive apnea.

Snoring is not the same as sleep apnea. Snoring is caused by a change in airflow, but this does not necessarily mean that the patient is suffering from apnea. Mild snoring may cause no problems. Patients with severe snoring may also have apnea. *Upper airway resistance syndrome* occurs in snorers who are not subject to apneic episodes but who wake up because their snoring is so loud and their breathing is impeded.

Obstructive Sleep Apnea

Clinical Signs and Symptoms

Clinical signs and symptoms of obstructive sleep apnea include intermittent snoring, excessive daytime sleepiness, gasping or choking causing awakening, fragmented light sleep, poor memory, morning headaches, and gastroesophageal reflux disease. Sleep bruxism may occur as a result of OSA. Sleep bruxism has been defined by the American Sleep Disorders Association as “tooth grinding or clenching during sleep plus one of the following: wear, sounds, or jaw muscle discomfort in the absence of medical disorder.” Sleep bruxism results in microtrauma, defined as overloading with moderate forces over a long period of time (parafunctional activity). Cardiovascular symptoms are also associated with OSA, and include systemic hypertension, cardiac arrhythmias, cerebrovascular disease, and pulmonary hypertension.



In children, signs and symptoms include hyperactivity, poor concentration, enuresis, nocturnal mouth breathing, headaches, nightmares, earaches and developmental delay.

Risk Factors for Sleep Apnea

Risk factors for sleep apnea include obesity, increasing age, male gender, family history, alcohol or sedative use, smoking, hypertension, breathing disorders such as asthma, menopause (due to a change in sex hormone levels), and anatomic abnormalities of the upper airway. Further risk factors include malocclusion of the teeth and bruxism, which can affect the upper airway.

Skeletal morphometric risk factors include high palate, narrow dental arch, and excessive overjet.⁵ Breastfeeding is important in the proper development of airways. The palate of a newborn/infant is quite malleable. During breastfeeding and also during a young infant’s normal swallow, the tongue shapes the palate by placing pressure on it. If a child is breastfed and has a normal swallow, the palate will have a normal height and the dental arch will be a nicely rounded “U” shape.⁶

Screening for Obstructive Sleep Apnea

Sleep-disordered breathing is under-diagnosed. Among physicians who are not sleep specialists, 76% do not screen or evaluate patients for OSA alone – this number does not include screening for other types of SDB that are less severe than OSA.

Dentists have a unique opportunity to screen patients for OSA. Screening should include both physiological and predisposing behavioral factors, and consider the possible signs, symptoms, and risk factors.

Screening
Complete medical and dental history
Intraoral and soft-tissue assessment (include all three regions of the upper airway)
Periodontal evaluation
Orthopedic/TMJ/Occlusal examination
Initial radiographic assessment (panoramic, full mouth and lateral cephalometric radiographs)
Diagnostic models

When conducting the soft-tissue assessment, all three regions of the upper airway should be examined. It is important to include evaluation for hypertrophy of the tonsils, a draped soft palate that hangs over the airway, the size and shape of the uvula, size and position of the tongue, and scalloping of the tongue (this has been found to be 70% diagnostic for OSA⁷).

Diagnosis of Obstructive Sleep Apnea

If after screening it is believed that the patient is suffering from obstructive sleep apnea, he or she should be referred to a physician or sleep specialist for a differential and definitive diagnosis. Diagnostic tests performed will include completion of the Epworth Sleepiness Scale to assess sleepiness. Sleep-disordered breathing is an intrinsic disorder that can also result in insomnia – the converse is not true. A definitive diagnosis of OSA is made following an overnight sleep study, known as a polysomnogram (PSG), whereby the patient’s sleep is monitored and measured throughout the night. Alternatively, home diagnostic tests can be performed – these range from measurements of the blood oxygen level (pulse oxymetry) to measurement of everything that the laboratory polysomnogram measures. It is important to remember that without a definitive diagnosis of OSA from a physician or specialist, the dentist should not treat the patient for OSA. Without a definitive diagnosis following a sleep study, there is no legal or medical basis for treating the patient.

Treating Obstructive Sleep Apnea

There are several general measures that the patient can take to help the situation. General measures including losing weight, sleeping on your side, avoiding alcohol two to three hours prior to sleeping, and avoiding certain medications (such as benzodiazepines, narcotics and barbiturates). The treatment options available for OSA are CPAP, surgery, and oral appliance therapy.

Surgery

Surgical approaches include uvulopalatopharyngoplasty (UVPP), laser-assisted uvullectomy (LAUP), somnoplasty, and orthognathic surgery. UVPP involves excision of excess soft-tissue of the palate, tonsils, uvula, and the posterior and lateral walls of the oropharynx. The success rate for UVPP has been found to be less than 50 percent. Laser-assisted uvullectomy – removal of the uvula – is less invasive and has become a common procedure. Somnoplasty uses radiofrequency to coagulate a region of tissue at high temperature, after which the tissue in the area shrinks. Orthognathic surgery is carried out to advance the mandible if the mandible is deficient. If a patient has a deficiency of both the maxilla and mandible, the position of both the mandible and the maxilla can be advanced – this has been found to be 96 percent successful in these cases.

Continuous Positive Airway Pressure (CPAP)

CPAP uses a device that forms a pneumatic splint and is placed over the patient’s nose during sleep. The device is obtrusive and not mobile. CPAP opens up the airway with positive pressure and has been found to be effective for moderate to severe OSA. Compliance with CPAP is poor and has been estimated to be less than 50 percent. Its use is associated with a number of problems including laceration of the bridge of the nose (caused by the mask), rawness of the throat, bloating of the stomach, nasal congestion, and sleep deprivation. There is also concern with respect to reduced cardiac output and renal function.

Oral Appliance Therapy

Oral appliance therapy is effective in the treatment of mild to moderate cases of OSA. It is also useful in the treatment of snoring. The American Academy of Sleep Medicine (physician organization that defines the diagnosis and treatment for these disorders), recommends that oral appliances be used for patients who have been diagnosed with mild and moderate apnea. Oral appliances may be worn overnight, during the day, or both, depending on the individual patient's treatment. The Food and Drug Administration (FDA) has cleared several types of oral appliances as effective in the treatment of SDB. Patient compliance with oral appliances is significantly higher than compliance with CPAP and has been found to be between 60 percent and 70 percent after three years of use.⁸ Success rates have been found to be as high as 76 percent. A definitive diagnosis and establishing who may benefit from airway dilator therapy is essential. Guessing can be dangerous as it can lead to over-titration, insufficient titration, or apnea (normal or silent).⁹

Acoustic pharyngometry/rhinometry can be valuable in determining the position for optimal airway patency and in triage for those patients who would not benefit from appliance therapy.¹⁰ Acoustic vibrations (sound waves) are used to map the nasal and oral airways. In this way the clinician is able to determine the size of the airway, its collapsibility, and its cross-sectional area. This technique is quick, painless, and completely non-invasive. Recordings are taken in different mandibular positions (changes in vertical or protrusion) to determine the optimal position.

Oral Appliances

Oral appliances are available as one arch or both arches, "boil-and-bite" appliances, and appliances that are custom designed and fabricated for the individual patient. Boil-and-bite appliances are not recommended – they are inaccurate and do not specifically address the underlying problem. Custom-fabricated oral appliances include adjustable appliances, non-adjustable mandibular repositioners, tongue retainers, and palate lifters.

Adjustable Appliances

Elastic Mandibular Advancement® Appliance (EMA)

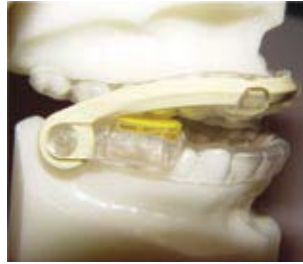
EMA I



This appliance consists of pressure-molded clear upper and lower trays. The trays are joined together by elastic bands. The bands are available in a number of lengths,

enabling the dentist to regulate the amount of mandibular movement. The EMA I is easy to wear, allows for lateral and anteroposterior movement, and is inexpensive. However, the straps may lose elasticity and the pads can be difficult to adjust.

EMA II



This is similar to the EMA I, except that it has one strap which curves up under the upper lip to the opposite side. Patients may find the elastic bulky under the upper lip, and it has a short life span.

The Thornton Adjustable Positioned® T-TL (TAP® T-TL)



The TAP® T-TL consists of two clear custom-fabricated trays, with an anterior screw device that is used to move the mandible forward. The screws also provide for vertical adjustment. The device allows for 25 mm of lateral freedom and can be adjusted anteroposteriorly. It is infinitely adjustable anteroposteriorly, and vertical adjustments are possible in 0.25 mm increments. However, over-titration is possible and if used incorrectly, this device can produce disc dislocation.

The Silencer®



The Halstrom Hinge™



This appliance consists of two clear elastomeric custom-fabricated trays. It is fully adjustable, featuring a titanium precision attachment that allows for up to 10 mm of adjustment in a vertical and/or anteroposterior detention. The appliance permits lateral movement of the mandible. Hard acrylic bite pads are placed on the molar regions that help to protect the TMJ and dentitions. The soft elastomeric material is comfortable for the patient. This appliance is excellent for TMJ support and bruxers; it can be used for edentulous patients. Some patients, however, experience it as bulky and it is expensive to produce. To fabricate a Silencer, after the impression is taken, the maximum forward and sideways movements of the jaw should be recorded using a jaw tracker.

OASYS Oral Airway System™

The appliance consists of a lower appliance and an upper splint. The upper splint should be seated prior to seating the lower appliance. The lower appliance is custom-fabricated with thermal acrylic that is softened chairside to enable seating – failure to do so correctly may result in the appliance fracturing. The upper splint is constructed of hard, clear acrylic. Initially, the mandible is repositioned 70% of the maximal protrusion. The inter-incisal vertical opening is 3 mm. The OASYS Oral Airway System is the first device cleared by the FDA as a mandibular repositioner for the treatment of sleep apnea and snoring as well as a nasal dilator to reduce resistance and improve nasal breathing. This dual-purpose appliance is easily adjustable and the locks can be opened up to adjust it. It is excellent for asthmatics and allergy patients. However, it should be noted that the device has only anteroposterior movement. Additionally, the upper labial impression must be exact.

Oasys Oral Airway System™



Adjustable Herbst® Sleep Appliance

This appliance consists of two occlusal splints held together with a bilateral Herbst® screw and tube assembly. This allows the mandible to be postured forwards. The appliance permits free mandibular movement vertically and laterally, and prevents the mandible from dropping back during sleep. Maximum retention is achieved by using ball clasps. Easy adjustments to anterior positioning of the mandible are possible. The palate is not covered by the upper splint, improving comfort. Patients may find the tube assembly obtrusive. Vertical adjustments are not possible.

Adjustable Herbst® Sleep Appliance



CPAP PRO®

The CPAP PRO® uses a dental mouthpiece that snaps over the upper teeth to retain the device, negating the need for a mask or straps (as required for the CPAP). Two flexible tubes convey CPAP air to the nostrils. Foam-filled nasal inserts provide nasal seal.

The CPAP PRO® provides positive fit and controls airway pressure. It is somewhat bulky and obtrusive.

CPAP PRO®



Non-Adjustable Appliances

These appliances are non-adjustable – once fabricated, the mandible is held in a fixed position using these appliances.

The SnoreFree™ Appliance



This is a one-piece appliance that is fabricated chairside. It is useful as an initial test appliance and inexpensive. However, it is less precise than a laboratory custom-fabricated appliance, and holds the mandible in a pre-determined position.

Tongue-Retaining Appliances

The Tongue Retaining Device



This appliance is fabricated with flexible polyvinyl material. It fits over the upper and lower teeth, with a “bulb” anteriorly that the tongue fits into. This bulb can be squeezed to create suction that will help hold the tongue in position in the bulb. The tongue retaining device has been found to produce excellent results in sleep studies, and to be effective in moving the tongue away from the airway. However, it can be uncomfortable to wear, and can produce soreness of the tongue after a short time.

Palate Lifters

The Soft Palatal Lift Appliance



This appliance is constructed of acrylic and has adjustable acrylic buttons that extend distally to the midpoint of the soft palate. The appliance gently lifts the soft-tissue up and prevents it from vibrating as air passes through. This palate lifter is difficult to wear, but it is a good diagnostic aid to see if wearing it stops snoring and helps the patient breathe. If this is the case, UVPP or LAUP may be indicated.

Keys to Success

There are several keys to success in the treatment of these disorders. Inappropriately treating patients for OSA can lead to medical problems. A definitive diagnosis and triaging is essential to ensure that appropriate patients receive oral appliance therapy, and that there is a medical and legal basis for this therapy. Patient selection and deselection is key. Appliance selection and diligent case management are then required for successful treatment.

Appliance selection

Selection of an appliance that meets the requirements of the individual patient is critical. Simple guidelines that help appliance selection are to choose an appliance based upon the assessed level of obstruction and cause of the obstruction. Depending upon the situation, the first appliance may serve as a diagnostic tool (for example, the palate lifter or a simple device to assess if a more complicated mandibular repositioning appliance will work).

Case management

Diligent case management is important. Patients should be seen at follow-up intervals for evaluation, and should be asked about their appliance-wearing at each appointment.

Questions to ask patients during treatment

Are you still wearing your appliance?

How many nights per week?

Are you able to sleep with your appliance?

Was snoring eliminated?

Was any gasping or choking observed while you were asleep?

Did you appear to stop breathing at any time?

Is your breathing any different from before you had the appliance?

Are your teeth sore in the morning?

Were there any other side effects?

Common side effects with the use of oral appliances include excessive salivation, tooth discomfort, dry mouth, tissue irritation, and changes in the occlusion. The patient must be monitored for these.

Treatment must be cross-functional and include other health care professionals. This is necessary for primary diagnosis and treatment of OSA. However, it is important to also note the fact that OSA is associated with a number of medical conditions requiring the attention of physicians and specialists. Such conditions include cardiovascular disease, elevated protein levels (proteinuria), hypoxemia, hypercapnia and hypothyroidism.¹¹

Follow-up and management of patients being treated with oral appliances should include a one-year treatment cycle. A follow-up management cycle can be seen in the table below.

Follow-up and Management

Week one:	Telephone consult
Week four:	Microadjustments
Week eight:	Follow-up sleep study
Six months	Follow-up appointment
One year:	Follow-up appointment

Summary

Sleep disordered-breathing is a common problem. Obstructive sleep apnea is a serious health issue that can be treated using surgery, CPAP and oral appliances therapy. Oral appliance therapy is a viable, non-invasive treatment for patients with mild to moderate OSA. Oral appliance therapy has a high success rate and good patient compliance. Dental professionals are in a unique position to assess and treat patients with OSA using oral appliances. Keys to success in treating patients with an oral appliance include patient selection following a thorough clinical examination and a definitive diagnosis of OSA, selection of the appropriate appliance, and case management during treatment.

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Endnotes

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Questions

1. About _____ Americans suffer from a sleep problem.
 - a. 20 million
 - b. 40 million
 - c. 70 million
 - d. 90 million
2. _____ of men with moderate to severe obstructive sleep apnea have not been clinically diagnosed.
 - a. 62 percent
 - b. 73 percent
 - c. 82 percent
 - d. 95 percent
3. Sleep-disorder breathing can be categorized as _____.
 - a. Snoring
 - b. Upper airway resistance syndrome
 - c. Obstructive sleep apnea
 - d. All of the above
4. A person is considered to have obstructive sleep apnea if _____.
 - a. A partial cessation of breathing for at least 20 seconds
 - b. A complete cessation of breathing for at least 5 seconds
 - c. A complete cessation of breathing occurs at least 30 times during 7 hours of sleep
 - d. None of the above
5. Cardiovascular symptoms associated with obstructive sleep apnea are _____.
 - a. Systemic hypertension
 - b. Coronary and ischemic heart disease
 - c. Stroke
 - d. All of the above
6. Sleep bruxism may occur as a result of OSA.
 - a. True
 - b. False
7. Sleep bruxism is defined as _____.
 - a. A sensory disorder
 - b. An oromotor disorder
 - c. An oromotor movement disorder
 - d. None of the above
8. Risk factors for obstructive sleep apnea include _____.
 - a. Obesity
 - b. Anatomic abnormalities of the upper airway
 - c. Male gender
 - d. All of the above
9. A general measure that can help if a patient is suffering from OSA is _____.
 - a. To lose weight
 - b. To sleep on your side
 - c. To avoid alcohol two or three hours prior to sleeping
 - d. All of the above
10. Oral appliance therapy is recommended for patients with _____.
 - a. Mild obstructive sleep apnea
 - b. Moderate obstructive sleep apnea
 - c. Severe obstructive sleep apnea
 - d. a and b
11. Success rates using oral appliance therapy to treat obstructive sleep apnea are as high as _____.
 - a. 50 percent
 - b. 62 percent
 - c. 76 percent
 - d. 82 percent
12. Boil-and-bite appliances specifically address the occlusal and TMJ relationship.
 - a. True
 - b. False
13. Guessing which patients may benefit from airway dilator therapy _____.
 - a. Is dangerous and can result in over-titration
 - b. Is sometimes the only thing possible
 - c. May be necessary if no machinery is available
 - d. None of the above
14. The position for optimal airway patency can be determined _____.
 - a. Using a pharyngometer
 - b. Using a rhinometer
 - c. a and b
 - d. None of the above
15. The TAP® T-TL appliance _____.
 - a. Allows for 25 mm of lateral freedom
 - b. Can be adjusted anteroposteriorly
 - c. Can produce disc dislocation
 - d. All of the above
16. The Silencer _____.
 - a. Allows for vertical adjustments
 - b. Allows for anteroposterior adjustments
 - c. a and b
 - d. None of the above
17. Appliance therapy is always a complete alternative to CPAP.
 - a. True
 - b. False
18. The OASYS Oral Airway System™ _____.
 - a. Consists of a lower appliance
 - b. Consists of an upper splint
 - c. Is a mandibular repositioner and nasal dilator
 - d. All of the above
19. Non-adjustable appliances _____.
 - a. Hold the mandible in a fixed position
 - b. Are non-adjustable
 - c. a and b
 - d. None of the above
20. The key to success in oral appliance therapy is _____.
 - a. Appropriate patient selection
 - b. Appropriate appliance selection
 - c. Diligent case management
 - d. All of the above

ANSWER SHEET

Sleep-Disordered Breathing

Name: _____

Title: _____ Specialty: _____

Address: _____ E-mail: _____

City: _____ State: _____ ZIP: _____

Telephone: Home () _____ Office () _____

Instructions to obtain dental continuing education credits: 1) Complete all information above. 2) Complete answer sheets in either pen or pencil. 3) Mark only one answer for each question. 4) Successful completion of this course will earn you 3 CEUs. 5) A blank duplicate answer sheet may be copied for additional course participants.

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Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

1. How would you rate the objectives and educational methods?
 5 4 3 2 1 0
2. To what extent were the course objectives accomplished?
 5 4 3 2 1 0
3. Please rate the course content.
 5 4 3 2 1 0
4. Please rate the instructor's effectiveness.
 5 4 3 2 1 0
5. Was the overall administration of the course effective?
 5 4 3 2 1 0
6. How do you rate the author's grasp of the topic?
 5 4 3 2 1 0
7. Do you feel that the references were adequate?
 Yes No
8. Do you feel that the educational objectives were met?
 Yes No
9. If any of the continuing education questions were unclear or ambiguous, please list them.

10. Was there any subject matter you found confusing?
 Please describe.

11. Would you participate in a program similar to this one in the future on a different topic? Yes No
12. What additional continuing dental education topics would you like to see?

- | | | |
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| <ol style="list-style-type: none"> 1. ① ② ③ ④ 2. ① ② ③ ④ 3. ① ② ③ ④ 4. ① ② ③ ④ 5. ① ② ③ ④ 6. ① ② ③ ④ 7. ① ② ③ ④ 8. ① ② ③ ④ 9. ① ② ③ ④ 10. ① ② ③ ④ 11. ① ② ③ ④ 12. ① ② ③ ④ 13. ① ② ③ ④ 14. ① ② ③ ④ 15. ① ② ③ ④ | | <ol style="list-style-type: none"> 16. ① ② ③ ④ 17. ① ② ③ ④ 18. ① ② ③ ④ 19. ① ② ③ ④ 20. ① ② ③ ④ 21. ① ② ③ ④ 22. ① ② ③ ④ 23. ① ② ③ ④ 24. ① ② ③ ④ 25. ① ② ③ ④ 26. ① ② ③ ④ 27. ① ② ③ ④ 28. ① ② ③ ④ 29. ① ② ③ ④ 30. ① ② ③ ④ |
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