

SNORING AND OBSTRUCTIVE SLEEP APNEA

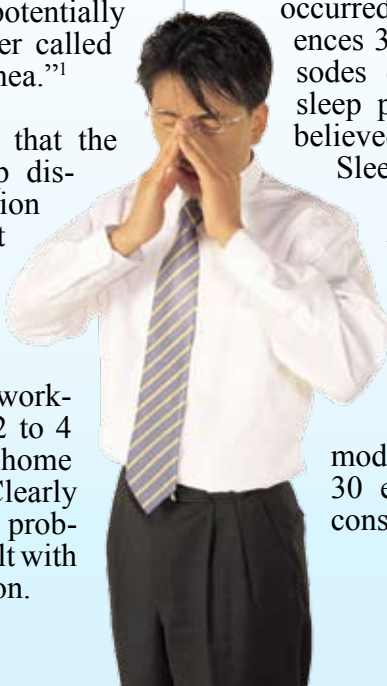
» PRACTICE POTENTIAL:

Have you wondered why, all of a sudden, your dental patients are asking if there is something you can do to help them with their snoring? It's because in today's information age, they can't read a paper, listen to the radio or watch television without learning something about the latest electronic device, herbal medicine, nasal strip, surgical technique or dental appliance being used to treat snoring.

If you snore loudly and often, you may be accustomed to middle of the night elbow thrusts and lots of bad jokes. But snoring is no laughing matter. That log-sawing noise that keeps everyone awake comes from efforts to force air through an airway that is not fully open.

Perhaps ten percent of adults snore and although for most people snoring has no serious medical consequences, for an estimated one percent of snorers habitual snoring is the first indication of a potentially life threatening disorder called "Obstructive Sleep Apnea."¹

It has been estimated that the indirect costs of sleep disorders are over 41 billion dollars a year from lost productivity, 17 to 27 billion dollars a year from motor vehicle accidents, seven billion dollars a year in work-related accidents and 2 to 4 billion dollars a year in home and public accidents. Clearly this is a major national problem that needs to be dealt with in an appropriate fashion.



Unfortunately, most physicians have not been trained to deal with these common problems. It has been estimated that on average during the four years of medical school only two hours are spent teaching medical students anything about sleep. This has created a significant deficit in our current medical system.

Dentists can provide a role in recognition and treatment of Snoring and Obstructive Sleep Apnea. To provide optimal care, the dentist must have an overview of the complex process of sleep and sleep disorders.¹

» DEFINITIONS:

What is Sleep Apnea?

Steadman's Medical Dictionary defines "apnea" as the absence of breathing or the want of breath. When there is a cessation of airflow at the mouth and nose for more than 10 seconds an apnea episode has occurred. If a person experiences 30 or more apnea episodes during a seven-hour sleep period, then they are believed to be suffering from Sleep Apnea.^{2,3}

Apnea severity is usually categorized by the frequency of apnea episodes.² 5-15 episodes per hour is mild, 15-25 episodes per hour is moderate, and more than 30 episodes per hour is considered severe.

These episodes can last anywhere between 10 to 20 seconds each, terminating with at least a partial awakening. Typically, a patient may have as many as 300 apneic episodes per night.

There are three basic classifications of sleep apnea: central, obstructive, and mixed.

Central apnea- air flow stops because inspiratory efforts temporarily cease. Although the airway remains open, the chest wall muscles make no effort to create airflow. The etiology frequently is encephalitis, brainstem neoplasm, brainstem infarction, poliomyelitis, spinal cord injury, and cervical cordotomy.⁴

Obstructive apnea- is the cessation of airflow due to a total airway collapse, despite a persistent effort to breathe. An obstruction in the upper airway can occur in three areas. They are the nasopharyngeal, oropharyngeal and hypopharyngeal regions.

Regardless of the level, an obstruction causes the breathing to become labored and noisy. As pressure to breathe builds, muscles of the diaphragm and chest work harder. The effort is akin to sipping a drink through a floppy straw, the greater the effort the more the collapse. Collapse of the airway walls eventually blocks breathing entirely. When breathing stops, a listener hears the snoring broken by a pause until the sleeper gasps for air and awakens but so briefly and incompletely that he/she usually does not remember doing so in the morning.¹

Mixed Apnea- is a combination of central and obstructive apnea usually beginning with a central episode being immediately followed by an obstructive one.²

What is Snoring?

Many people think that snoring and apnea are the same thing. This is not true. Snoring, which is caused by a change in airflow through the nasal and pharyngeal tissues, is only a sign that a patient may be suffering from apnea. It's basically like water running through a pipe. If the water runs abnormally through the pipe it will vibrate. The same thing happens with airflow when it is partially obstructed.

Snoring can be categorized by its severity. On one side of the spectrum, you have the benign snorer, who snores but experiences no physical problems. On the other side of the spectrum, you have the snorer who suffers from apnea, and in the middle you have the snorer who suffers from what we call **Upper Airway Resistance Syndrome**. In these people, though they may not actually experience apnea episodes, their snoring is so loud and their breathing is so labored, that it still wakes them up numerous times throughout the night. This leaves them unrefreshed and tired in the morning.

» THE ROLE OF THE DENTIST:

Because the etiology of obstructive sleep apnea is multifactorial and the treatment options are varied, proper diagnosis and treatment are best handled by a team approach. Members of this team may include a sleep specialist, an ENT, an internist, an orthodontist, an oral surgeon, and a general dentist. As a general dentist, you should play an active role in:

- screening your patients
- treating them in conjunction with other sleep specialists
- providing them with follow up treatment.

Screening:

Adults

To properly screen your patients, you must evaluate them for the presence of any physiologic and behavioral predisposing factors.

A complete evaluation will reveal some of the possible physiologic factors.

It should include the following:

- Complete medical / dental histories.
- Soft tissue / intraoral assessment.
- Periodontal evaluation.
- Orthopedic/TMJ/occlusal examination
- Intraoral habit assessment.
- Examination of teeth and restorations
- Initial dental radiographic survey (panoramic, full mouth x-rays and a base line lateral cephalometric survey).
- Diagnostic models.⁶

While doing the soft tissue/intraoral assessment part of the exam, you should evaluate all three regions of the upper airway.

An obstruction in the naso-pharyngeal area is usually caused by turbinate hypertrophy, a deviated septum, or an abnormal growth like a polyp. Although documenting a problem in this region is the job of an ENT, you can at least check your patients to see if they have a patent nasal airway.

When evaluating the oropharyngeal region, first check for hypertrophy in the tonsils. Then check the size and position of the tongue as it relates to the soft palate. Finally, look at the size and drape of the soft palate and the uvula. When the soft palate is excessive or drops down immediately, there is a good chance that this patient will suffer from an oropharyngeal blockage.

An obstruction in a hypopharyngeal airway space is a lot harder to detect through observation alone. We do know that when motor nerve activity stops during REM sleep, the tongue can drop back against the posterior pharyngeal wall and block the airway. Cephalometric films can give us some information on whether an airway is blocked. Although it is a two dimensional view of a three dimensional space we can get an idea of the relative size of the airway, the posterior airway space, the length of the soft palate and the position of the mandible, maxilla and the hyoid bone. But to truly be meaningful they should be taken in the supine position with the patient asleep and this is very difficult to accomplish.



HTL
Health Technology Limited

One of the more exciting developments in the past few years has been the incorporation of the Eccovision System by Health Technology Limited as a diagnostic tool to thoroughly and accurately assess the patient's airway. Completely painless and non-invasive, the Eccovision emits sound waves through a self-contained central processing unit comprised of two tools: the rhinometer and pharyngometer. They map the patient's nasal passages and pharyngeal airway, respectively, via a technique called 'acoustic reflection'. The results are on-screen graphs directly correlating to the physicality of the patient's nasal passages and pharyngeal airway. When used properly these tools do two things:

1. They will identify the area of obstruction
2. Graphically display the changes in the oral airway with lower jaw advancement and vertical changes so you can see the effect an oral appliance has on oral airway size.

A new component of the physical exam has also been developed which is called the Chin Press/Tongue Curl Maneuver. This maneuver is based on the changes that occur in the mandible's position during sleep. During sleep the lower jaw in most patients drops back into the most retruded position. The Chin Press attempts to put the chin in the most retruded position while the patient is supine or reclined in the exam chair. MRI studies clearly show that when an obstruction occurs with the Chin Press/Tongue Curl Maneuver, there is a strong correlation with the degree of severity of apnea as seen in a polysomnogram. It is important to recognize though that a negative Chin Press/Tongue Curl does not rule out a diagnosis of Sleep Apnea.

Signs & Symptoms:

The following are some of the signs and symptoms that are indicative of a person who is suffering from apnea:

Adults

- Heavy snoring
- Gasping or choking during the night
- Excessive day time sleepiness
- Frequent arousals during sleep (fragmented sleep)
- Non-refreshed sleep
- Restless sleep
- Morning headaches
- Nausea
- Personality changes such as becoming irritable or temperamental
- Severe anxiety or depression
- Poor job performance
- Clouded memory
- Intellectual deterioration
- Occupational accidents
- Impotence
- Decreased sex drive
- Bruxing
- Dry mouth when you awaken
- Scratchy throat

Children

Children can suffer from sleep apnea as well. Typically these children suffer from growth and development problems. A lot of them have under-developed maxillas, narrow upper arches, and retruded mandibles. Often they are highly allergic with their airway completely blocked due to tonsillar hypertrophy. If they are already having snoring and breathing problems, do not ignore them. Here are some of the signs and symptoms seen in children:

- Hyperactivity
- Poor concentration
- Developmental delay
- Hyponasal quality to their voice
- Noisy breathers
- Obesity
- Frequent upper airway infections
- Earaches
- Bedwetting
- Nocturnal mouth breathing
- Snoring
- Restless sleep
- Nightmares
- Night terrors
- Headaches
- Chronic nose running

»» DIAGNOSIS:

If you do suspect that a patient may be experiencing apnea episodes, then refer them to a physician immediately. Either an ENT, a sleep specialist, an internist or an oral surgeon can work with you to make sure your patient gets a complete medical work-up and a sleep test.

A proper medical work-up by a physician can detect physiologic changes as well. Typically these patients will exhibit a fragmented sleep pattern, experience excessive daytime sleepiness, and have a change in their CO₂/O₂ ratio, causing acidosis. You will also find that these patients tend to have hypertension. Some will show signs of altered heart function like cardiac

dysrhythmias and premature ventricular contractions. Someone suffering from apnea episodes can also end up having anoxic seizures, cardiopulmonary arrest and even experience sudden death.

Even after a thorough evaluation by the dentist and the physician, a definitive diagnosis of OSA can only be accomplished by a sleep test called a polysomnogram. During sleep, a polysomnogram measures ventilation, gas exchange, cardiac rhythm, the number and length of apneic episodes, assesses oxygen saturation, determines sleep stages, and detects arousals. In the past, this test could only be done in a hospital sleep clinic. Today, we have mobile sleep technology that allows you to take this test in the comfort of your own home.

Most major medical insurers will require patients to undergo a full blown PSG (Polysomnography) study in a sleep lab for primary diagnosis prior to paying for any treatment. However, in recent years ambulatory sleep study devices have entered the dental market and are beginning to play an important role in proper treatment protocol. Patients with a high insurance deductible, or no medical insurance, may prefer the low cost of diagnosis with an ambulatory study as opposed to the relatively high cost of a PSG. An ambulatory study, with a physician's signature, is a legal diagnosis that a dentist can use to justify treatment.

Currently there are three major ambulatory sleep study devices available to dentists, the Remmer's Sleep Recorder (Sagatech), the SNAP and the Watch-PAT 100. The Remmer's and the SNAP both use traditional methods for determining presence of obstructive sleep apnea; nasal/oral airflow, snoring, chest effort, position, pulse, oxygen saturation. The Watch-PAT 100 uses a proprietary system to monitor the sympathetic nervous system. All three units have studies showing a

relatively high correlation with a PSG test and the respective device. Dentists are cautioned to avoid using simple overnight pulse oximeter studies as means to verify appliance efficacy or diagnose OSA. Oxygen saturation is one component of proper diagnosis, but in many mild/moderate cases oxygen saturation statistics alone will not show a significant problem even though apnea exists.

» TREATMENT PROCEDURES:

Once you understand some of the basics in sleep medicine, it becomes clear that the dentist can play a role in both the prevention and treatment of snoring and OSA.

Early detection of structural abnormalities in the developing child affords us the opportunity to intervene with functional therapy possibly preventing another eventual OSA casualty. For example, after a thorough orthopedic evaluation, the dentist may then decide to use orthopedic appliances to direct and control a child's growth. Arch development, mandibular repositioning, and controlling vertical dimension can create the intraoral volume needed to accommodate the tongue and prevent its compaction into the hypopharynx.

Many treatment methods have been tried over the years to treat snoring and obstructive sleep apnea. To date, three approaches seem to be the most effective. They are Continuous Positive Airway Pressure (CPAP), surgical techniques, and the use of intra-oral appliances. Regardless of the technique used, most people benefit by following a few general measures.

General Measures:

1. Lose weight- People with severe sleep apnea are almost always over weight. Losing weight will reduce redundant tissue volume in the upper airway, decrease the load on the chest wall and abdomen, and improve respiratory

muscular efficiency. In mild cases, weight reduction alone may result in a cure. In other cases it enhances the effects of additional therapy.

2. Sleep on your side- Many studies have shown that patients who sleep on their back have a significantly higher level of sleep disturbance. It is believed that sleeping in the supine position causes a gravitational pull on the tongue forcing it to come in contact with the posterior pharyngeal wall. Therefore any technique that keeps you sleeping on your side could be beneficial.
3. Avoid alcohol within two to three hours of bedtime. Alcohol is a central nervous system (CNS) depressant and changes motor activity to the muscles that control normal inspiration. These changes create unfavorable forces in the upper airway causing it to collapse.
4. Avoid certain pharmacological agents- Benzodiazepines, narcotics, barbiturates, and testosterone have all been reported to affect the occurrence of apnea episodes. For example, Flurazepam has been shown to worsen apnea episodes in patients who already suffer from this disease and trigger apnea in patients who have no history of a problem.

Specific Measures:

Continuous Positive Airway Pressure (CPAP): This technique involves wearing a mask tightly over the nose during sleep. Pressure from an air compressor is used to force air through the nasal passages and into the airway. The forced air creates a pneumatic splint, keeping the airway open and allowing the person to sleep normally. When accepted by the patient, this treatment is highly effective and is considered the "Gold Standard" on which all other treatments are compared. To increase patient acceptance, many improvements have been made over the last few years. Some of these

innovations include having the ability to vary the pressure rate during inspiration and expiration (BiPAP) to using a mask that doesn't need straps to hold it in place (CPAP-Pro). Even with all the improvements that have been made, this treatment modality is still not for everybody. In fact, daily compliance by patients using CPAP is less than 50%. Besides being uncomfortable, the other negatives to this treatment are that it is inconvenient, it restricts a patient's movement and it dries out the airway mucosa. There is also a real concern of having reduced cardiac output and renal function.²⁶

Surgical Approaches:

Surgical treatment of OSA began with the tracheostomy, which enjoys a 100% success rate because it completely bypasses all the sites of upper airway obstruction. Even though a tracheostomy often results in immediate relief of symptoms, patients poorly accepted it as many cannot accept the idea of a permanent tracheostomy. A number of complications emerge with time. They are tracheal site infection, physiological problems, granuloma formation, chronic irritation, uncontrolled secretions, bronchial infections, and eventual stenosis.⁹

Nasal reconstruction

A nasal obstruction causes a patient to mouth breathe. When you open your mouth to breathe, the mandible rotates back and allows the base of the tongue to drift posteriorly and block the airway. A nasal obstruction also eliminates the use of CPAP as a choice of treatment. Surgical procedures to clear the nasal airway are done to correct turbinate hypertrophy, septal deformities, alar collapse and the removal of tumors or polyps.

Although nasal surgery in and of itself has not been shown to be an effective treatment for OSA, a clear and patent nasal airway is very important for normal respiratory function.

UPPP

Uvulopalatopharyngoplasty was first introduced by Ikematsu in 1964 and later by Fujita in 1981. This surgical procedure enlarges the air space by excising redundant soft tissue of the palate, uvula, tonsils, posterior and lateral pharyngeal walls. When the airway obstruction is at the oropharyngeal level, this procedure can be quite successful at stopping snoring. However, if the obstruction is below the oropharynx, this surgery is contraindicated. Most clinical investigations indicate that the success rate of this surgical approach to correct OSA is less than 50%. This is due to the level and cause of the obstruction often being misdiagnosed. Removing some of the vibrating tissues may resolve snoring, but it does not prevent an obstruction by the base of the tongue. This is a serious surgery that is not without its complications. Post-operative stenosis, significant post-operative pain, and infection are all possible complications of this approach.

LAUP

A laser Assisted Uvulectomy is a modification of UPPP surgery. It is accomplished using lasers and is considered a less invasive procedure. It is commonly being used to remove the redundant soft tissue of the palate believed to be causing snoring.

Somnoplasty

This procedure uses a radio frequency to heat the tissue to a very precise temperature creating a finely controlled lesion of coagulation within the tissue. Over a period of four to six weeks, the injured tissue heals and in the process the tissue shrinks and tightens. This technique can be used to reduce the excess tissue in the soft palate, the nasal turbinates and the tongue.

This procedure generally takes two to three treatments to shrink the tissue sufficiently to have a clinical effect. Patients seem to have minimal side effects making it one of the more promising procedures for treating snoring and sleep apnea.

Orthognathic Procedures:

The position of the hyoid complex, mandible, tongue and the size and position of the maxilla all play a role in an obstruction at the hypopharyngeal level. The goal of a surgical approach here would be to make more room for the tongue and/or take the base of the tongue away from the posterior pharyngeal wall.

In patients with a mandibular deficiency, surgical advancement to a normal occlusal relationship can bring the base of the tongue away from the posterior pharyngeal wall. When both a maxillary and mandibular deficiency exists, a bimaxillary surgery will provide more physical room for the tongue as well as increase anterior tension on the tongue musculature. Waite et. al. have shown a 96 percent improvement when bimaxillary advancement surgery was the primary surgical procedure. In patients with a normal dental occlusion who need no additional tongue space, a procedure called an anterior inferior genial osteotomy can be done. This is the site of the attachment for the genioglossus muscle. In this procedure, only this part of the mandible is advanced anteriorly. Theoretically this should pull the tongue forward to improve the hypopharyngeal airway. Various procedures have also been designed to reposition the hyoid bone and thereby advance the base of the tongue.⁷

Dental Appliances

Numerous appliances are available to treat snoring and obstructive sleep apnea. Research has shown that many appliances are quite effective and can now be considered an alternative when choosing a treatment modality. In fact, sleep appliances offer several advantages over other therapy choices. They are inexpensive, non-invasive, easy to fabricate, reversible, and quite well accepted by patients.

The basic indications for sleep appliances are to treat primary snoring and mild to moderate obstructive sleep apnea. Attempting to

make an appliance is particularly appropriate for those patients who cannot handle CPAP. When surgery is contraindicated or your patient is unwilling to go through a surgical procedure, then appliance therapy may be the way to go.

The treatment objectives for appliance therapy are to reduce snoring to an acceptable level, resolve the patients' OSA problems, get a higher amount of oxygen into their systems, and eliminate excessive daytime sleepiness; allowing them to function normally.

Sleep appliances seem to work in one or a combination of three ways. Appliances can reposition the soft palate, bring the tongue forward, or lift the hyoid bone. As they reposition, they also act to stabilize these tissues, preventing airway collapse. Lastly, appliances seem to increase muscle tone. Specifically, there seems to be an increase in pharyngeal and genioglossus muscle activity.

Variations in design range from the method of retention, the type of material being used, the method and ease of adjustability, the ability to control the vertical dimension, differences in mandibular movement and whether it is lab-fabricated or made in the office. The appliance design that you choose will be dependent upon our knowledge of these variations and the oral conditions of the patient. In selecting an appliance don't forget to evaluate the health of the TMJ, the periodontal structures and the number and health of the teeth.

Palate Lifters

The Soft Palatal Lift Appliance

Many patients have excessive or pendulous tissue in the oral pharyngeal region that obstructs the airway and causes snoring. The Palate Lift appliance has an adjustable acrylic button that extends distally to the midpoint of the soft palate and gently lifts this tissue, preventing it from vibrating as air passes during sleep.



This appliance is hard for most patients to tolerate for any length of time, but when you suspect that the airway obstruction is due to an excessive palatal drape, this appliance might prove useful as a diagnostic tool. Simply have the patient wear it to sleep for an evening. If it clears the airway enough for them to breathe and their spouse tells you that they didn't snore while wearing it, then this may indicate the need for a UPPP surgery. This appliance is rarely used and is shown here to give a historical perspective on the evolution of appliance design.

Tongue Retainers

The Tongue Retaining Device



In this appliance the tongue goes into the anterior bulb. Pushing the tongue forward and giving the bulb a little squeeze creates a suction that holds the tongue in a forward position. It is a lab-fabricated appliance and is made out of a flexible polyvinyl material. This appliance works, and it has excellent sleep studies to support its use but is not very comfortable.

Most of the other appliances that are used to clear the airway in the hypopharyngeal region work by bringing the mandible forward.

But not everyone can bring his or her mandible forward. If your patient suffers from a TMJ problem, bringing the tongue forward with an appliance like this may be the best way to clear the airway. Patients who are edentulous or periodontally compromised may also benefit from this appliance.

The Snor-X



One of the latest appliances is called the Snor-X; it was developed by Dr. Alvarez in the San Francisco area. The Snor-X can be used as a test appliance or as a training device to see if the TRD can be worn. It can also be used as a treatment appliance. Just like the TRD, it holds the tongue forward so it can't drop back. The Snor-X is not retained on the teeth in any manner and allows total freedom of movement of the mandible.

Non-adjustable Mandibular Repositioners

The Clasp Retained Mandibular Repositioner

CT scans taken with this device in place show that the tongue is more superiorly placed with a narrowing of the dorsal aspect. There is also an enlargement of the airway. This appliance uses multiple clasps to positively lock the mandible into the appliance and prevent it from retruding. Because it is a one-piece appliance, you can control the vertical dimension by changing the height of the appliance. There is also a larger airway cut into the acrylic in this design.

The position of the mandible must be pre-determined and accurately produced in a construction bite for proper appliance fabrication. Typically, the mandible must be advanced to only 75% of its maximum protrusion with the anterior vertical separation of 4mm. This prevents excessive strain on the TMJ and facial musculature.



The Mandibular Inclined Repositioning Splint (M.I.R.S.)



An open airway is maintained with this appliance by directly holding the mandible in a forward position. An incline flange is used to direct the mandible forward and prevent it from dropping back upon opening. This flange is made out of a thermoplastic material that softens at body temperature making it more comfortable and greatly reducing the possibility of soreness to the anterior teeth and tissues.

The body of the appliances is fabricated from hard clear acrylic and snap fits to the maxillary arch. The lower dentition is deeply indexed into the occlusal surface of the appliance to hold the mandible in the forward position. A breathing hole is placed in the anterior portion of the appliance to allow for easy breathing throughout the night.

The position of the mandible must be pre-determined and accurately produced in a construction bite for proper appliance fabrication. Typically, the mandible must be advanced to only 75% of its maximum protrusion with the anterior vertical separation of 4mm. This prevents excessive strain on the TMJ and facial musculature.

The Dorsal Appliance



The Dorsal Appliance utilizes precision milled upper and lower occlusal splints to open the vertical relationship while holding the mandible in the desired forward position by the use of interlocking buccal inclines. The inclines are milled in such a way that they allow a degree of mandibular lateral movement alleviating the occurrence of any muscle trismus. The inclines also aid in keeping the mandible from dropping open during sleep.

The SnoreFree™ Appliance



The SnoreFree™ comes with a complete kit.



The SnoreFree™ is a one-piece thermoplastic mandibular repositioning appliance that is made chair side. It comes in a kit that contains everything from complete instructions to all the forms necessary to screen your patients for snoring and apnea. When treating obstructive sleep apnea with a dental appliance, the SnoreFree™ is often used as an initial or test appliance. This allows the dentist to inexpensively evaluate whether a mandibular repositioning appliance will work for that patient. If it does, the dentist may then want to choose one of the other appliances that are titratable.

Adjustable/Titratable Appliances

The Clark (U.C.L.A.) Modified Herbst® Appliance

This appliance consists of two occlusal splints held together by a bilateral Herbst® tube assembly. This setup allows the mandible to positively be postured forward. Posturing the mandible forward brings the tongue anteriorly to open up the air-

way. This unique design allows the patient to move the mandible freely in both a vertical and lateral direction while at the same time preventing the mandible from dropping back during sleep. Because the Herbst® tubes are placed buccally to the teeth, there is nothing to interfere with the patient's tongue position and patients find this design extremely comfortable.



Users of this appliance typically provide a construction bite taken with the mandible positioned 75% of the way from maximum intercuspation to maximum protrusive with a 4mm vertical opening in the anteriors. This appliance can also be titrated forward from its initial position by adding shims in 1mm, 2mm, and 3mm increments.

The occlusal surfaces of the upper and lower portions of this appliance are carefully milled into full contact. Vertical elastics are used in the cuspid region to create a proprioceptive response that encourages a lip together posture. Maximum retention is achieved through multiple ball clasps on both the upper and lower portions of the appliance.

The Adjustable Herbst® Sleep Appliance



Having the ability to easily bring the mandible forward in small measurable increments is often the difference between success and failure when using a sleep appliance to treat apnea. Although this can be accomplished with the original U.C.L.A. design by adding shims to the Herbst assembly, this new Herbst® screw allows us to incrementally bring the mandible forward with greater ease and adjustability. As with its predecessor, the palate is clear of any obstruction that would encourage the posterior placement of the tongue. In all other aspects, this appliance is identical to the original design.

The Klearway™ Appliance



This appliance is a mandibular repositioning appliance. It is fabricated with a thermo active acrylic giving it excellent retention and comfort for the patient. It has an expansion screw in the palate that allows you to adjust the mandibular position in 0.25mm increments. Lateral and vertical jaw movements are sufficient to allow the patient to yawn, swallow and drink water without dislodging the appliance. Its adjustability makes it a very good appliance. Data from a large clinical trial, funded by the Canadian government, indicated a 78% success rate for the treatment of sleep apnea.

The EMA, Elastic Mandibular Advancement® Appliance



This appliance consists of upper and lower custom pressure-molded clear trays that are joined together by flexible elastic bands. These elastic bands come in various lengths and degrees of flexibility allowing the dentist to regulate the precise amount of mandibular advancement and lateral movement desired. These parameters will be different for every patient. Because the bands are easily changed, you will be able to quickly find the right set of bands that provided your patient with optimal results.

The Original TAP®



This appliance incorporates two hard outer polycarbonate shells that are lined with a unique thermoplastic polymer blend, called ThermAcryl™. ThermAcryl™ has the right balance of flexibility and rigidity to give the TAP excellent retention without tooth movement. Although initial fabrication of the appliance is accomplished on stone casts of your patient's arches, an even more precise fit is accomplished at delivery by heating ThermAcryl™ and molding it to the patient's dentition.

Attached to the upper and lower dual laminate thermoplastic trays is a unique hook and screw device that is used to bring the jaw forward to maintain an open airway. This hook and screw provides 8mm of vertical adjustment, a minimum of 25mm of lateral freedom and is infinitely adjustable anterior-posteriorly.

Although the initial trial position of the appliance is set at delivery, the dentist is not limited to a range of predetermined positions with the TAP®. An adjustment knob is used to advance the mandible 0.25mm with each turn. The patient can vary the position precisely by counting the turns. This allows both the dentist and the patient to confidently maintain the proper treatment position and yet be able to vary it depending on the patient's symptoms. This feature also allows titration of the appliance in the sleep lab by a technician or the adjustment at home by the bed partner if the patient's symptoms return while that patient is asleep.

Once the ideal treatment position has been determined, the dentist or patient can elect to remove the adjustable device. In such a case, a locking nut is then applied to fix the hook in one location. If adjustment again becomes necessary, the change can easily be reversed.

Another unique feature of the TAP® is that it has a unique universal mount for a CPAP mask that bolts to the adjustment mechanism. For the severe apneic, the TAP® reduces the required pressure while providing a leak-free, stable, "strapless" mask system.

The information on this appliance has been provided for historical perspective as the other designs shown in this bulletin are far superior. The other appliances in the TAP series perform in the same manner, but provide great improvements over the original design.

Clasp Retained Hard Acrylic TAP®



Although the ThermAcryl™ material used in the original TAP® has the benefit of allowing you to improve the retention of the appliance chair-side regardless of the accuracy of the models, if the appliance is not meticulously maintained, it can delaminate and/or become difficult to keep clean.

To eliminate the possibility of delamination and provide a cleansable appliance, a hard acrylic clasp retained TAP® was designed. The clasps can be easily adjusted throughout treatment to maintain retention. In all other aspects this appliance is identical to the original design.

The Multi-laminate TAP®



Many patients prefer the comfort of a soft material against their teeth. To accomplish this, a layer of soft ethyl vinyl acetate has been incorporated into the design of the TAP®. This is accomplished by laminating three separate layers together under high heat and pressure. What is created is a clasp-free appliance that uses the buccal and lingual undercut for retention.

The TAP® T-TL



The TAP® T-TL is the latest innovation in the TAP appliances. Its components are made of a nickel-free biocompatible titanium alloy that has been widely used for dental and medical implants. The TAP® T-TL hardware is much smaller than the other TAP designs allowing for lip closure and a more comfortable fit. As opposed to the original design this appliance does not protrude beyond the lips. This is a great improvement leading to greater patient acceptance. While the TAP® T-TL hardware is improved, its function is the same as the TAP® and the TAP® II.

The Snore-Aid®



This appliance is designed to open the upper airway by mandibular repositioning and antero-superior repositioning of the tongue. It combines a single mandibular bite plate, which has a flat occlusal surface, with an external lip shield. The appliance is titrated by manually adjusting the shield in a rearward direction upon a calibrated anterior extension off of the dental plate. This action advances the lower plate relative to the lip shield, thus advancing the mandible. Titration of this appliance can be made immediately and it can be done even while it is being worn. The adjustment is also easily reversible.

Some of the benefits of this design are that it has no palatal structure to interfere with an ideal antero-superior tongue position. In fact, the mandibular plate is wide enough that it actually helps to elevate the tongue as the mandible is advanced. This supports the genioglossus muscle and prevents it from settling posteriorly and inferiorly into the pharynx. The occlusal surface of the appliance is designed so that the maxillary dentition contacts uniformly. This gives the mandible complete freedom to function laterally and vertically. The bite plate surface can also be customized to alter the vertical dimension. This makes this appliance ideal for nocturnal bruxers and for patients undergoing diurnal splint therapy for TMJ dysfunction. The appliance itself can be made out of hard acrylic with ball clasps for retention or with a thermoplastic material bi-laminate splint like our Talon® splints.

The Adjustable PM Positioner®



The Adjustable PM Positioner® designed by Dr. Jonathan Parker, is recognized as a very effective intra-oral appliance that has proven 70% effective for patients with mild to moderate obstructive sleep apneas and 90% effective for managing patients' snoring. The Adjustable PM Positioner® can be fabricated with standard clear acrylic or with thermoplastic material that softens in warm water. Bilateral expansion screws are attached on the buccal aspect of the appliance to offer ample space for the tongue and to allow a degree of freedom of jaw movement in a lateral or protrusive direction. This helps to increase jaw comfort. Mandibular position can be altered

in an anterior/posterior direction by using an expansion screw key to turn the screw mechanisms on each side of the appliance.

Once you have decided that treatment with a PM Positioner® is appropriate, you must first take accurate impressions of the patient's upper and lower arches and a construction bite. Both impressions should reveal clear detail of the teeth and gingival tissues and extend at least 2 mm beyond the most posterior teeth. The Construction Bite should be taken with the mandible positioned at approximately 60% of maximum protrusion. When posturing the mandible forward be certain that the patient does not deviate to the right or the left. To aid in achieving these results we recommend the use of a PerfectBite or a George Gauge. When taking this bite make sure that the anterior teeth are separated by 3 to 5 mm.

Because of the design of this appliance there are very specific placement and removal procedures that need to be followed. For example, if you have ordered the PM Positioner® made in the thermoplastic material, you will want to place the appliance under warm/hot water to soften the material first. Then insert the upper portion of the appliance over the upper teeth and have the patient move the mandible forward and close slowly into the mandibular portion. When doing this, the patient should not have to use excessive force to place the mandible firmly into the lower portion of the appliance. Similar detailed instructions exist for the removal of the appliance.

The Silencer®

The Silencer designed by Dr. Wayne Halstrom is a laboratory fabricated fully adjustable oral appliance that features a titanium precision attachment (Halstrom Hinge) which controls the anatomical settings of the appliance. It is capable of anteroposterior adjustment as well as vertical adjustment through a range of 10mm, in both dimensions.



The Halstrom Hinge™

The design of the precision attachment also allows lateral movement of the mandible, which respects and protects the TMJ. The adjustable component is made of implant grade titanium and carries a five-year warranty. The body of the appliance is constructed of an elastomeric pliable material that offers the patient a much greater degree of comfort than harder acrylic materials. For additional support to the dentition, as well as the temporomandibular joint, hard acrylic "bite pads" are placed in the molar regions. An implant grade pure titanium articulating component grants the appliance the many adjustment characteristics that make the Silencer unique - kind to the tissues, the teeth, and the temporomandibular joint. The Silencer® can also be used for the partially or completely edentulous patient. Fitting the Silencer® requires the following steps:

1. An impression is made of the patient's teeth at a dental office.
2. Measurements of the forward and sideways maximum movements of the jaw are recorded using a GAT™ gothic arch tracer.
3. The impression is sent to the dental laboratory for manufacturing and assembly of the Silencer® Professional with the Halstrom Hinge™
4. The patient returns to the sleep professional's office for fitting.

5. The patient is required to return for follow-up appointments, which may include adjusting the Halstrom Hinge™ to achieve the optimum setting for airway dilation.

The OASYS Oral Airway System™



The OASYS Oral/Nasal Airway System™ is the first dental device to be reviewed by both the dental and ENT divisions of the FDA and to be approved as a dental device for treatment of snoring and sleep apnea through mandibular repositioning and also as a nasal dilator for reduction of nasal resistance and improved nasal breathing. The appliance acts as a nasal dilator by maintaining a stretch in the nasal labial tissue to dilate the internal nares. A greater volume of air is delivered to the oropharynx with less effort thus reducing the negative pressure in the throat. It also maintains the patency of the oropharyngeal airway by functioning as a mandibular repositioner.

The OASYS consists of two parts: the device itself and an upper splint. When seating the appliance, begin by fitting the upper splint over the upper dental arch as you would for a periodontal splint or an orthodontic retainer. The lower appliance, however, is fabricated with thermal acrylic. It must be softened in warm tap water before placing it in the patient's mouth. If this is not done properly you may find the appliance difficult to seat, or you may run the risk of fracturing the appliance. Be sure to make this instruction very clear to your patient.

Because of the unique design of this appliance, getting an upper impression that extends all the way up into the vestibule is important. An easy method for capturing the upper vestibule is to use a Monoject 35 CC syringe with catheter tips (#888-1) as an alginate syringe to inject alginate into the anterior vestibule and then taking the alginate impression of the upper arch. This will easily capture the upper vestibule region for the construction of the upper flange.

At the initial fabrication of the appliance the mandible is advanced 70% of maximal protrusion and the vertical has a 3 mm inter-incisal opening. To further adjust the mandibular position, the locks can be easily loosened just enough to slide along the wire up against the tube one side at a time. To adjust the Nasiolabial button position, the initial adjustment can be made before inserting it in the patient's mouth. Further adjustments can be made by having the patient keep his mouth closed while opening the lips enough to introduce your index finger then bend the button in the desired direction. Next check the amount of stretch on the tissue and adjust to get a moderate stretch without discomfort. Have the patient breathe through the nose for a few minutes. This should become easier after a brief period of use. If you have instrumentation to measure the nasal volume, such as an Acoustic Rhinometry, as mentioned in this PBB, the initial readings should be made prior to fitting with the after treatment readings made after a few minutes of usage to appreciate the effect.

The CPAP PRO®

CPAP has a 50% failure rate because patients find most masks unbearable to wear. However, nightly CPAP doesn't have to be torture. A new CPAP interface called the CPAP PRO® may be the answer to a better night's sleep. Unlike all other masks and nasal devices that require straps and/or other headgear to keep them in place, the CPAP PRO® utilizes a simple customized

dental mouthpiece that easily snaps onto the upper teeth. A small thin bracket is attached to the dental mouthpiece and extends outward through the lips, to support the fully adjustable CPAP PRO®. Two highly flexible tubes convey the CPAP air into the nostrils. Unique nasal inserts, which are foam filled and inflate slightly during use from the CPAP pressure, provide excellent nasal sealing with just feather-light pressure applied to the nostrils. Regardless of all the twisting and turning that occurs throughout the night, the CPAP PRO® stays in positive position with the nose.



» CHOOSING AN APPLIANCE

You can very effectively treat both snoring and sleep apnea with appliances if you remember that there are often multiple factors involved in causing the patient's problem. In fact, it is possible for there to be an obstruction in the hypopharyngeal, oropharyngeal and nasopharyngeal regions at the same time. If you do not work in a team approach to properly identify the causes of the obstruction, appliances will work only 50% of the time regardless of the appliance chosen. Even under the best circumstances, you will often end up utilizing more than one appliance before finding the best one for the patient. The following simple guidelines may help you select the best appliances for your patient:

1. Choose an appliance based upon your team's clinical assessment of the level of the obstruction, then evaluate its effectiveness.
2. Your first appliance often acts as a diagnostic tool or as a trial appliance. For example, if you suspect a hypopharyngeal block-age and the patient has a retruded mandible, a Snore-Free™ may be your appliance choice. It can be used to assess if a mandibular repositioning approach works to clear the airway. You can also use it to evaluate if your patient can tolerate a forward mandibular position. If it works, it may be your final treatment appliance or you may choose another mandibular repositioner. If it does not work, at least you haven't spent \$200 or more on a lab-made appliance. If your patient cannot tolerate it, perhaps a TRD would be more appropriate.
3. Your trial appliance can also be used to help determine whether a surgical approach could be effective. For example, if one of these appliances achieves some measurable level of success but the patient just can't tolerate it on a daily basis, an orthognathic surgery, which repositions the chin or the mandible, may be an acceptable alternative.
4. The Academy of Dental Sleep Medicine has established an excellent protocol for the use of dental appliances. They can be reached at 708-273-9366. We highly recommend that you follow their guidelines.

» PROVIDING FOLLOW-UP THERAPY

When we work as a team, oral surgeons, internists, ENTs and sleep labs, all have their role. Ours is to be in charge of the appliance therapy. The attending dentist should do selecting, fitting, and monitoring of appliances.

Periodic evaluation of these appliances is a must. When they are kept clean and stored properly, we see them lasting a long time. However, patients will occasionally break them or wear through them. When someone is being successfully treated with an appliance they simply won't go home without a replacement. Therefore, it is a good idea to keep a few "in office" appliances around like the SnoreFree™ so you can immediately replace a lost or broken appliance.

Some of the questions you should be asking during follow-up visits are:

- Are you able to sleep with the appliance?
- Is it comfortable?
- Are your teeth sore in the morning?
- If so, for how long?
- Is your bite different from normal in the morning?
- Does your jaw hurt?
- If so when and for how long?
- Did your partner hear you snore?
- Was it as loud as usual?
- Was any gasping or choking observed?
- Did you appear to stop breathing at any time?
- Was your breathing any different from prior to the appliance placement?
- Did you wake often?
- Did you feel more refreshed in the morning?
- How did you feel the rest of the day?
- Do you have any other comments or concerns?

If your patients are suffering from OSA and you are treating them with an appliance, they must have a follow-up polysomnogram to evaluate the effectiveness of the appliance. Once they are subjectively doing better, i.e. their excessive daytime

sleepiness is gone, they are feeling great, their energy level is back, and they are not snoring at night, then it is time to go for the second sleep study.

Another valuable role ambulatory sleep studies such as the Watch-PAT 100, the Sagatech, or the SNAP test perform is to verify efficacy of the appliance. Once an appliance is delivered it is important to have another sleep study done on the patient in order to have objective data showing the appliance has effectively treated the OSA. Patients widely prefer an in-home study option as opposed to having to return to the sleep lab for another test.

» CONTRA INDICATIONS AND CONCERNS

As a dentist, it is essential that you work as part of a team of health care professionals. This is particularly important because many other medical conditions can be associated with OSA.² Some of these are:

- Increased hypertension.
- Elevated protein levels (Proteinuria).
- Angina pectoris – more likely to develop.
- Initiation of a gastroesophageal reflex.
- Frequent nocturnal voiding.
- Hypoxemia.
- Hypercapnia (high blood level of CO₂).
- Cardiac changes –bradycardia, tachycardia, & right heart failure, possibly leading to sudden death.
- Susceptibility to atherosclerosis.
- Hypothyroidism- causing polythycemia and bicarbonate retention.

Make sure that your patient gets a proper sleep test. Taking a polysomnogram is the only way to make the distinction between someone who snores and someone who is actually suffering from apnea. For

those who have patients who are a little hesitant to go and take a sleep study, as an initial step, you may give them a pulse oximeter to take home. This will at least allow you to measure their oxygenation level during sleep. Showing them that they have a decreased oxygenation level is often the extra push they need to have a complete sleep test done.

Treatment of Snoring and OSA with dental appliances without first having a definitive diagnosis confirmed by your medical team could cause the patient to become worse, not better. For example, some appliances may alleviate snoring giving the patient and doctor the false impression that the appliance is working, when in fact it is possible that the patient's apnea episodes could be getting worse even though their snoring has decreased.

Sometimes you may go through a series of appliances trying to find one that works and still not be successful. Appliances simply do not work all the time. Therefore treating an unmotivated patient is clearly a contraindication to Appliance Therapy. If you can't find an appliance that works, then CPAP or even a surgical approach may be appropriate.

As with any other mandibular repositioning appliance, you will need to make sure that the patient's occlusion stays stable. Even though most appliances cap the teeth, you can still get flaring and other occlusal changes.

Some of the common side effects that you see with the use of sleep appliances are excessive salivation, discomfort in the teeth, a dry mouth, tissue irritation from mouth breathing, temporary disharmonies in the bite and some pain in the joints. It is essential to respect the TMJ when considering the use of a repositioning appliance. A proper TMJ exam is recommended and if a patient is found to suffer from TMJ dys-

function or their muscles are sore and painful while wearing a repositioning appliance, you may need to use the Tongue Retaining Device (TRD). Appliance use is contraindicated for patients diagnosed with Central apnea.

» SUPPLY LIST:

- SnoreFree Appliance*
- Snor.X Appliance*
- Transparent Acrylic Kit*
- Acrylic Curing Unit*
- Acrylic Burs*
- Brush Mounted Mandrills*
- Retainer Polishers*
- Herbst Spacers*
- T.A.P. Parts*
- Hot Water Bath*
- Per-Fect Bites*
- Passports to a Healthy Smile*
- Appliance Cleaning System*
- Appliance Care C.D.*
- Retainer Brite*
- Appliance Bath*
- Brace Relief Kit*
- Appliance Case*

*Available from Success Essentials, call 800-423-3270

» LAB FEES:

The range of fees for an appliance to treat snoring and apnea is between \$70 for an in-office fabricated appliance to \$700+ for a lab fabricated appliance using titanium parts. All the appliances presented in this bulletin have been used successfully. There are many variables which determine whether an appliance will be successful in treating OSA. Since appliances do not always work, it makes sense to try an appliance that is less expensive first.

Customary Fees & Getting Paid:

Fees for treating obstructive sleep apnea with appliance therapy average between \$300 and \$2500. This variation in fees is dependent upon the number of appliances and appointments needed to accomplish

a positive result. This fee should include your examination, clinical work-up and all the appliances. Out-of-office services such as sleep studies, tomograms/ceph x-rays, and any medical consultations or procedures are not included.

Payment may be obtained from medical insurance plans for the treatment of snoring and sleep apnea with appliances, but benefits differ dramatically from plan to plan. So payment through insurance is not always guaranteed.

When filing a claim, most insurance companies will request a referral from a physician. This should not pose a problem as you should already be working closely with a physician. As with any insurance claim, the more documentation you provide the more likely you will receive payment. So be prepared to send them a copy of the patient's sleep study and any other records they may request. Remember some insurance organizations require pre-authorization.

Dental insurance may also be billed, but at present there are no set codes. The Academy of Dental Sleep Medicine is working very hard to obtain new dental codes for this treatment. They can be reached at 708-273-9366.

» INCOME POTENTIAL:

Statistics show that one out of every ten people in your practice snore. But, if you don't find a way of telling your patients that you can help them, how are they going to know? Here are a few simple marketing ideas to help you reach your existing patients and bring new ones into the practice.

1. Place brochures on Snoring and OSA in your waiting room. We have created an excellent patient pamphlet called "Stop Snoring Before it Stops You." By reading this pamphlet, your patients will learn that you can help them with their sleep problem.

2. Revise your medical and dental questionnaires. Asking your patients the right questions can trigger a discussion on snoring and apnea. A few questions that you may want to add to your forms are: Do you snore? Do you wake up tired in the morning? Do you dream? Do you become extremely tired or fall asleep during the day? Are you overweight? Can you breathe through your nose? Do you drink before bedtime?
3. Re-evaluate your intraoral examination. If you are not spending the time to look at the oropharyngeal airway space, the hypopharyngeal airway space, the size of the tongue, the position of the mandible, the vault of the palate, and the nasal airway, then you are missing an opportunity to treat your patients for snoring and apnea.
4. Send out a newsletter. Newsletters are an excellent tool to keep your patients informed on what's new in your practice. Please feel free to use the information in this Practice Building Bulletin to make your letter.
5. Work closely with other medical professionals in a team approach. Referring patients to a physician or a sleep diagnostic center indicates your desire to make sure that your patients get the best care possible. It is this level of knowledge and expertise that will have sleep specialists willingly referring patients back to you for Appliance Therapy.

Do you remember the old movie, *Field of Dreams*? The famous line in that movie was, "If you build it, they will come." When it comes to treating Snoring and Apnea, if you treat one, they will come. Stop one person from snoring, and you will have patients knocking down your door. Treating just one patient per month can add up to \$30,000 a year to your gross income.

By Rob Veis D.D.S.

Director-Practice Development

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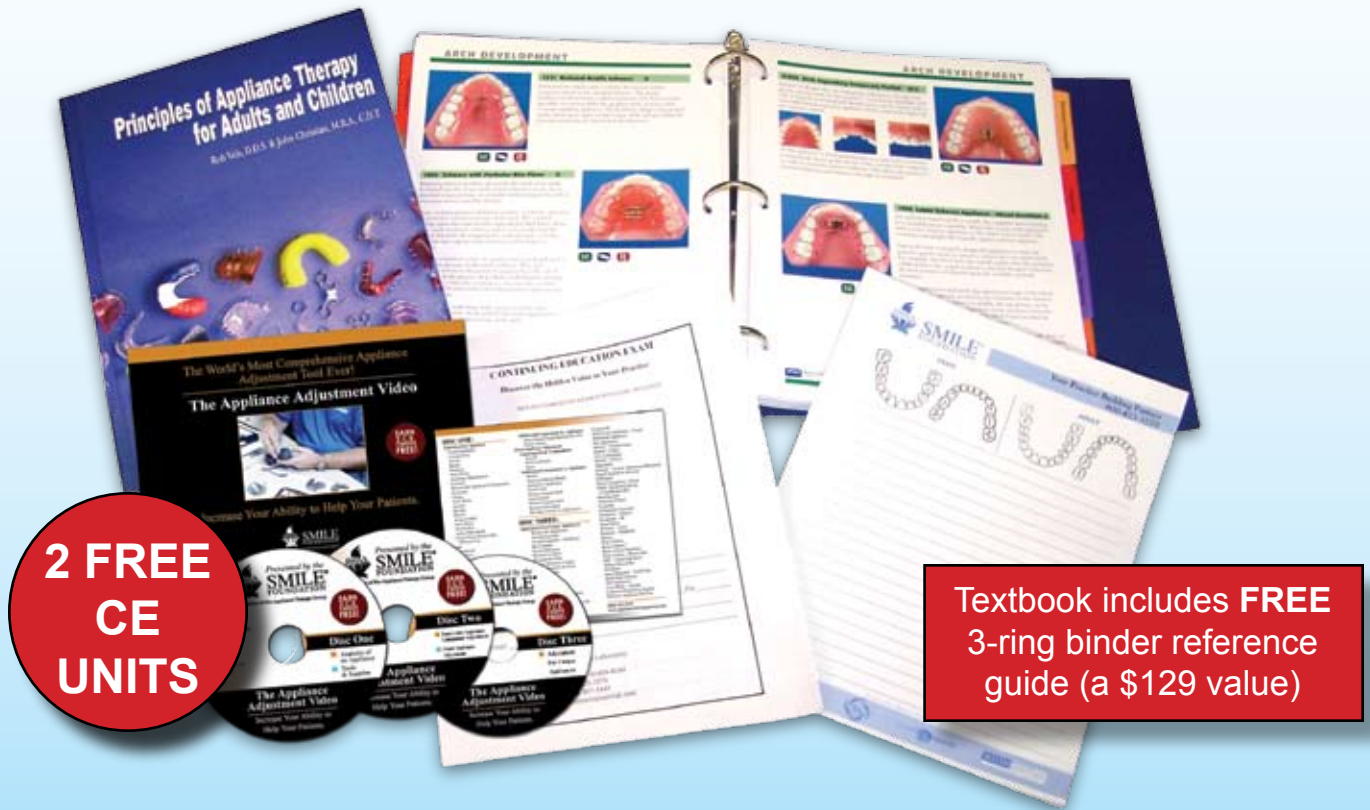
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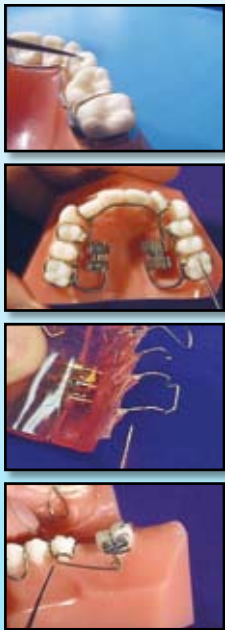
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