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## A Review of Oral Appliance Therapy in Sleep Populations

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*Further study into side effects and compliance is crucial for the complete understanding of the role that oral appliances will ultimately play in the management of sleep disordered breathing.*



The medical profession has sporadically attempted to affect airway patency during sleep over the past 100 years. In the early 1900s, surgeons occasionally saved the lives of micrognathic infants by suturing their tongues in a forward position to the lower lip in an effort to expand and stabilize the upper airway during sleep. Several decades later, helmets and chinstraps were recognized to reposition the mandible with similar results, and in 1934 French pediatrician Pierre Robin is reported to have placed the first oral appliance for this purpose. More recently, surgical advancement of the maxilla and mandible has been reported and in 1982, Charles Samelson, a psychiatrist who suffered from sleep disordered breathing (SDB), designed a tongue retaining device that has been shown to be effective.<sup>1</sup>

By the end of the century, the literature had grown to unequivocally support the use of oral appliances in the treatment of SDB. A milestone review appeared in 1995 that effectively summarized the efficacy of this contemporary therapy and, for the first time, suggested practice parameters.<sup>2,3</sup> The review concluded that therapy with oral appliances improved obstructive sleep apnea (OSA), appeared to be safe, and was accepted for long-term use. The practice parameters indicated that oral appliances would be suitable for initial treatment of simple snoring and mild OSA, and be appropriate alternative therapy in more severe cases when positive pressure was not tolerated and surgery was not indicated.

What has come to be known as oral appliance therapy (OAT) represents a unique opportunity to serve our SDB patients by merging the best that medicine and dentistry has to offer. The newly recognized sleep disorders dentist is being called on increasingly to interface with the medical sleep team to manage the unstable airway during sleep.

### Research

Following the basic queries of efficacy and protocol that the 1995 document addressed, investigators began addressing other specific areas to more fully support the use of oral appliances in the battle against sleep disordered breathing. Upper airway resistance syndrome and excessive daytime sleepiness were explored by Loube et al and Menn et al, respectively, in two different studies that documented the efficacy of oral appliances in these areas.<sup>4,5</sup> In addition, Millman et al have demonstrated that uvulopalatopharyngoplasty (UPPP) treatment failures responded favorably in a significant number of cases.<sup>6</sup>

When it became apparent that OAT was a legitimate and desirable part of the treatment mix, questions naturally arose regarding its comparative effectiveness with positive airway pressure modalities. Recently, four studies have focused on OAT going head to head with nasal continuous positive airway pressure (CPAP).<sup>7-10</sup> Three of them used a cross-over design and the fourth a parallel group design. All of the investigations were randomized,

controlled treatment trials. Each of the studies focused on effectiveness as a product of treatment efficacy in combination with acceptance and adherence to treatment. Treatment efficacy was similar in all the trials and did not deviate significantly from past investigations. It was shown that OAT often, but not always, decreased the apnea-hypopnea index (AHI) whereas CPAP nearly always resolved sleep disordered breathing entirely. Acceptance and adherence to treatment with CPAP were limited while that of OAT was less so, resulting in the proportion of successfully treated patients being about the same in each study. In all three crossover trials where patients were asked to choose a preferred treatment, the majority chose OAT.

### **Mechanism of Effect**

Loss of upper airway patency during sleep is multifactorial and it is believed that oral appliances function in several different ways.

Anatomic considerations play an essential role in airway collapse and it is presumed that a major effect of the oral devices is to physically reposition and stabilize certain tissues. In the experienced hands of a sleep disorders dentist, appliances can positively affect the repositioning of the tongue, mandible, soft palate, hyoid bone, and related pharyngeal muscles. A number of imaging techniques, including cephalometrics, MR, and endoscopy, have demonstrated airway opening with oral appliance use in the awake patient and the anesthetized patient.<sup>2,8,11-15</sup>

In addition to direct repositioning of the mandible and other tissues, it has been shown that placement of oral appliances can increase baseline genioglossus muscle activity<sup>16</sup> and a cephalometric investigation has documented a decrease in the length of the soft palate in responders to OAT.<sup>17</sup>

### **Appliance Types**

There are presently several dozen different oral appliances that are available to the sleep disorders dentist to manage the unstable upper airway during sleep. Despite the overwhelming variety, the appliances fall into two major functional categories: those that reposition the mandible and those that directly engage and reposition the tongue.

The mandibular repositioning devices (MRDs) are by far the most commonly used and have been studied the most extensively. They all function by repositioning the mandible in a protrusive position with more than two dozen design variations available although, to date, no significant research has clearly demonstrated any great advantage of one design feature over another.

Certain trends, however, are driving the evolution of appliance design and are vital for the practitioner to recognize. Of primary import is the serial protrusive adjustability of the MRD and the notion of titrating the device to ascertain both an effective and comfortable jaw position. A decade of anecdotal experience has made it abundantly clear that the initial jaw position is quite often not the most comfortable and effective for the patient and that appliances that offer protrusive capability that is quick, easy, reproducible, and available in very small increments most often offer significant advantage.

The tongue retaining devices (TRDs) are employed far less often than MRDs but offer the practitioner and patient alike an excellent alternative to mandibular repositioning. Therapy with TRDs has been objectively studied since the mid-1980s and shown to be effective in many cases.<sup>1,18,19</sup> TRDs function by directly engaging the tongue and maintaining it in a forward position throughout the night.

Few variations of the TRD exist and many practitioners have little or no experience with this functional classification. The major advantage of the TRD may be its ability to promote forward tongue position without having to engage the dentition or significantly stressing the temporomandibular joint (TMJ). As such, these appliances may offer significant advantage for patients with loose or no teeth or those with TMJ dysfunction.

### **Positive Airway Pressure—Orally**

It is well known that despite excellent efficacy, compliance with nasal CPAP has become a significant limiting factor in the widespread use of this modality. On the other hand, therapy with oral appliances, while more universally tolerated, is not as effective as CPAP.<sup>7-10</sup> As such, a hybrid device has been developed that seeks to maximize the benefits of each modality and overcome the shortcomings. Recently, the Food and Drug Administration has certified a delivery system that shows promise of being able to deliver positive airway pressure to the oropharynx via an intraoral apparatus that simultaneously protrudes the mandible. The intraoral apparatus is conceptually a one-piece, nonadjustable mandibular repositioning device with a dual palate designed to function with all forms of positive pressure delivery systems. Of particular interest is the finding that, to date, these hybrid appliances coupled with positive airway pressure appear to require less pressure than CPAP alone, most likely due to the mandibular advancement component.

A 1997 study examined 10 CPAP non-compliant patients with mild to severe OSA who were treated with orally delivered positive airway pressure via the protrusive oral device.<sup>20</sup> Post-treatment AHI levels were reduced to those comparable with nasal CPAP and in most cases the pressures were less than those required by nasal delivery. One case improved as a result of the mandibular protrusion alone in the absence of any applied pressure.

### **Protocol and the Dentist/Physician Relationship**

The merging of the dental and medical professions described herein will offer significant benefits to patients and exciting new opportunities to health care providers. This merger, however, is a work in progress and is not yet clearly set before us. Physicians grapple with questions such as which patients to refer for oral appliance therapy and how to locate a qualified sleep disorders dentist. Dentists must consider how to interface with their medical colleagues and how to monitor the progress of appliance therapy.

An accurate understanding of appliance efficacy will help the sleep physician determine which patients may be candidates for therapy with oral appliances. As previously noted, the 1995 Practice Parameters developed by the American Sleep Disorders Association<sup>3</sup> stated that therapy with oral appliances is indicated as a first-line approach for simple snoring and mild OSA and as an alternative in more severe cases when CPAP was not tolerated and surgery not indicated. Two recent studies have suggested that OSA severity can serve as a general predictor of treatment success. Marklund et al<sup>21</sup> and Lowe et al<sup>10</sup> have both shown increased appliance success with cases where AHI was less than 30. Similarly, Pancer et al<sup>22</sup> has identified the difference between responders and nonresponders at a mean AHI level of 39.

Although guidelines are useful, the notion of successful treatment is more complex than application of generalities. While overall predictability of appliance success may decline in severe cases, studies inevitably show certain cases of severe patients being “significantly benefited” if not “totally cured.” In the Pancer study, at least eight patients who were considered “non-responders” had pretreatment AHI levels of between 76 and 115 fall a mean 80% to post-treatment levels of between 11 and 30. In these cases, the committed clinician is often challenged to weigh the benefits and risks to the patient of varying degrees of residual sleep disordered breathing.

Schmidt-Nowara<sup>23</sup> offers the following model: CPAP is recommended to patients with AHI greater than 30, especially if they are significantly sleepy. Less severely affected patients, however, are offered OAT as the initial treatment choice. Patients who do not succeed with the initial choices are crossed over to the other treatment.

OAT demands that the dental and medical professions function as an integrated team. There are good reasons for this. At the present time, dentists are not medically qualified or legally capable of making the diagnosis of OSA and upper airway resistance syndrome and differentiating between primary snoring and these conditions. Similarly, physicians are neither medically nor legally capable of properly managing appliance construction, fitting and titrating, or the inherent concerns of tooth movement, TMJ dysfunction, and occlusal discrepancies.

Numerous approaches currently exist in the utilization of oral appliances that reflect differing degrees of experience, understanding, and philosophy. It is generally accepted that a successful team consists of a physician who thoroughly understands the concept of OAT and a dentist with adequate knowledge of sleep disorders who is educated and trained in handling oral appliances. Communication is critical as the physician refers the patient to the dentist along with objective data from the polysomnogram, multiple sleep latency test, Epworth Sleepiness Scale, or other appropriate indices. The sleep disorders dentist must be familiar with the significance of these data as well as the functional classifications and design variations of the myriad appliances available and choose one appropriate for the patient. It may take several weeks to several months to properly titrate the appliance to an effective and comfortable jaw position once construction and fitting procedures are complete. Finally, a referral back to the physician for objective follow-up evaluation completes the cycle. If the dentist and physician deem the therapy effective, the patient will then benefit from regular periodic monitoring by the dentist to ensure the integrity of the oral structures.

### **Complications and Side Effects**

As with any treatment modality, complications and side effects are important to understand and manage. Excessive salivation, transient discomfort of the teeth and temporomandibular joint, and dry mouth are often seen with use of oral appliances. These occurrences are generally minor and temporary and do not pose a significant obstacle to successful utilization. The mandibular repositioners almost universally cause a minor, temporary change in the occlusive relationship of the teeth the morning after use. In most cases, the mandible will return to its normal posture within an hour or two, allowing a return to normal dental occlusion.

Occasionally occlusive changes may persist, resulting in permanent changes in the patient's bite. Preliminary work by Lowe suggests that minor tooth movement can result from the nightly forces placed on the teeth by jaw repositioning appliances in approximately 20% of the cases. A published study by Bondemark<sup>24</sup> involving 30 patients showed that after 2 years' use of a jaw repositioning device, an overall change of 0.4 mm in mandibular position was seen. The mandibular posture changed between 0.5 mm and 2.0 mm in 17 of the 30 patients and did not change at all in the remaining patients. Interestingly, no significant tooth movement was documented and no patients reported an altered sense of occlusion. Recent anecdotal data suggest that certain jaw exercises that tend to gently retroposition the mandible may be effective in minimizing or preventing these changes.

### **Compliance**

Data on long-term compliance represent an area that requires further study. Bondemark<sup>24</sup> reports 100% compliance after 2 years' use of a mandibular repositioning appliance while other reports range from 100% to 52% compliance after 7 months to 3 years. Reasons given for noncompliance include objection to side effects, complications, and lack of efficacy. In general, however, it has been shown that patient preference and

adherence to treatment surpass those of CPAP.<sup>7-10</sup>

### **Dental Sleep Medicine**

Over the past 10 years, the scope of clinical dental practice has expanded to include management of the upper airway during sleep. The contemporary sleep disorders dentist provides unique skills and experience to the medical sleep team that are not available anywhere else. Presently, it is recommended that the sleep disorders dentist become involved in the care of the SDB patient on referral from a physician after the extent of the sleep disorder has been determined.<sup>3,25</sup> In addition, however, the astute dentist can serve an important role in the screening process so as to identify and refer patients to the proper sleep facility when a high degree of suspicion alerts the dentist to possible SDB.

Many physicians are seeking to partner with qualified sleep disorders dentists, but unfortunately, the number of dentists presently serving in this capacity is limited. Although it may be perplexing at times to locate an experienced dentist that a sleep physician feels comfortable referring to, it is possible for a committed dentist to acquire the necessary skills at the request of the physician.

There are many sources the prospective sleep disorders dentist may take advantage of to gain the background and experience necessary to provide appropriate therapy. A number of oral appliance manufacturing companies offer courses, seminars, and workshops that enable an interested dentist to become familiar with SDB and OAT and to get started in the field. Scientific journals and texts as well as information from local sleep centers can offer valuable information. The serious dentist will apply for membership in several of the various sleep societies and associations, perhaps most important, the Academy of Dental Sleep Medicine (ADSM).

The ADSM is a nonprofit, international network of clinicians and researchers providing education and training to dentists and physicians through numerous venues. A membership directory and information are available through its Web site, [www.dentalsleepmed.org](http://www.dentalsleepmed.org), or by phone at (724) 935-0836. Recently, the ADSM began offering credentialed status to those dental practitioners who have formally demonstrated certain proficient levels of knowledge and clinical competence. The Certifying Board of the ADSM grants credentials so that patients and professional colleagues can recognize these individuals as possessing the appropriate background and skills in sleep medicine and OAT to effectively interface with the medical team. The granting of such does not imply specialty status in any way.

### **Conclusion**

Therapy with oral appliances is well supported in the scientific literature, and many physicians and sleep centers have augmented services to their patients through inclusion of a sleep disorders dentist on the team. Further study into side effects and compliance is crucial for the complete understanding of the role that oral appliances will ultimately play in the management of sleep disordered breathing. Most important, perhaps, is the need for dentists and physicians to fully integrate their respective skills through effective communication.

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