

Role of oral appliances in treatment of obstructive sleep apnea patient: a review

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Abstract

Human beings spend approximately one third of their lives sleeping. Sleep disruption caused by breathing disorders is recognized as an important global health issue because of its prevalence and association with disease development and death.

Sleep apneas are classified into three types; obstructive, central, and mixed. Obstructive apneas are the most common type, and result from the collapse or obstruction of the oropharyngeal region of the upper airway. The most common symptoms associated with obstructive sleep apnea are loud snoring, disrupted sleep, and excessive daytime sleepiness. The treatment modalities consist of both surgical and nonsurgical methods. The nonsurgical approaches to treatment include weight loss, continuous positive airway pressure (CPAP) and oral appliances which include tongue retainer appliance and mandibular advancement appliance. Oral appliances have become increasingly popular for treatment of the obstructive sleep apnea syndrome, because of being a valuable alternative for treatment of patients who are not able to tolerate CPAP, due to its side effects.

Keywords: OSA, oral appliances, continuous positive airway pressure (CPAP), snoring

Introduction

Obstructive sleep apnea (OSA) is a common syndrome in which nasal and oral airflow ceases despite continued diaphragmatic efforts. It is aggravated by increased weight, micrognathia, macroglossia and any morphologic abnormality that contributes to a restricted upper airway.

Upper airway resistance is also increased in sleep apnea patients. The resultant increase negative inspiratory pressure is thought to be an important factor in airway collapse and obstruction.¹ Increased airway compliance may also contribute to airway collapse in the apnic patient. Inspiratory excitation of upper airway muscles maintains patency when awake. Excessive relaxation or loss of compensatory excitation of upper airway muscles explains the propensity to collapse during sleep.²

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OSA patients are sometimes hypertensive and may exhibit dangerous cardiac arrhythmias. Other complications include the development of severe day time sleepiness, loud snoring and disturbed night-time sleep.³

Treatment modalities of OSA include: Life style modification (weight loss, cessation of evening alcohol

ingestion, sleep position training), upper airway surgery, oral appliances and CPAP (continuous positive airway pressure device)⁴

Though CPAP is a reliable treatment modality for managing mild to moderate OSA, it is cumbersome for the patient⁵. Oral appliances have become increasingly popular for treatment of the obstructive sleep apnea syndrome, because of being a valuable alternative for treatment of patients who are not able to tolerate CPAP, due to its side effects like difficulty in sleeping, nasal dryness etc.⁶ This article reviews mechanism of action and efficacy of oral appliances.

Historical aspects

George Caitlin was probably the first person who seriously thought that the route of breathing may influence sleep quality and day time function⁷. 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 chin-straps were used to reposition the mandible, and in 1934 a French Pediatrician Pierre Robin was reported to have placed the first oral appliance for this purpose. More recently, surgical advancement of the maxilla and mandible were reported and Charles Samelson, a psychiatrist who suffered from sleep disordered breathing, designed a tongue retaining device (TRDs) in 1982. Although the type and number of specific appliances may be bewildering and ever growing, all may be divided into 2 general groups: - TRDs and MADs^(8, 9).

Tongue retaining devices (TRDs)

TRDs were first described in 1982 by Cartwright and Samelson,¹⁰. They consist of a hollow bulb supported by trays that fit over the maxillary and mandibular teeth or edentulous ridges. To prevent the tongue from approaching the posterior wall of pharynx, the patient projects the tip of tongue into the bulb, creating a suction which retains the tongue in an anterior position¹¹.

Mandibular advancement devices (MAD)

MAD's were first described by Pierre Robin in 1934 are the most common type of oral appliances used today. They provide for moving the mandible forward and

downward, thus preventing or minimizing upper airway collapse during sleep.¹² These devices can be either fixed (i.e. protrusion distance cannot be changed) or adjustable (protrusion may be increased or decreased)

Mechanisms of action of oral appliances

Anatomic considerations play an essential role in airway collapse and it is presumed that a major effect of the oral appliances is to physically reposition and stabilize the tongue, mandible, soft palate, hyoid bone and related pharyngeal muscles.

1. Effect on upper airway size

Simple active anterior movement of the tongue or mandible can increase cross sectional airway size in subjects with or without OSA^{13,14,15,16}

In the oropharynx, the palatoglossus and palatopharyngeous are active in controlling airway dimension. As the mandible is advanced and opened vertically, these muscles act in a synergistic manner and increases airway dimension.¹⁷

Ng et al.¹⁸ measured upper airway pressures during natural sleep in 12 patient with OSA to identify the site of airway collapse. The authors found that the oropharyngeal, rather than retropharyngeal area, was predictive of the beneficial response of the oral appliance. Other studies, using upright lateral cephalometry have shown that MADs lower the tongue position, reduce the mandibular plane to hyoid distance, advance the mandible and widen the upper oropharynx (retropalatal and retroglossal) in subjects having OSA^{19,20,21}.

2. Effects on upper airway muscle tone

Tongue retaining devices (TRDs) affects the genioglossal muscle activity in patients with OSA (awake or asleep) but effects of the TRDs on other upper airway muscles have not been evaluated²².

A TRD worn during sleep with the tongue in the bulb reduced genioglossus EMG activity²³.

3. Effect on snoring

Snoring is a cardinal symptom of obstructive sleep apnea syndrome, and is the reason why these patients come for treatment in the first place.

Palatopharyngeous and palatoglossus muscle have a role in reducing snoring. As the mandible is advanced the muscle are spread apart, causing tension on the palatoglossus. This is transferred to the soft palate, thus reducing vibration, hence snoring may be eliminated with mandibular advancement²⁴

The entire randomized, placebo appliance controlled studies found significant reduction in snoring, independently of whether it was assessed objectively or subjectively²⁵.

Oral appliance vs. CPAP

CPAP is the gold standard treatment of sleep apnea and it is regarded as being successful in approximately 62% of patient but CPAP suffers from poor patient compliance because of portability problems, pump noise, dryness of airway passage and mask discomfort²⁶.

McGown *et al* carried out a questionnaire survey of 126 patient treated with oral appliance. There were 41 patient who had tried both CPAP and oral appliance - 71% preferred oral appliance, 19 % preferred CPAP and 10% were unsure. This study favors oral appliance.²⁷

Side effects

Most common minor and temporary side effects induced mucosal dryness or hyper salivation, transient tooth or jaw pain, or masticatory muscle stiffness in the morning and occlusal changes in 6 to 86% of patient.²⁸. Occasionally these phenomena may prevent continued use of the appliances, though they are mostly minor and temporary in nature.

Conclusion

Oral appliances are generally accepted more easily than nasal continuous positive airway pressure device by patients. Oral appliances used to date, constitute a relatively heterogeneous group of devices for the treatment of sleep apnea. The evidence available at present indicates that oral appliances can successfully "cure" mild to moderate sleep apnea in 40-50% of patients and significantly improve it in an additional 10-20%. They reduce but do not eliminate snoring and side effects though common, are relatively minor. Their effectiveness is inferior to CPAP and similar to that of surgical procedures, which however carry the disadvantage of being invasive.

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