Oral Appliances for the Treatment of Obstructive Sleep Apnea

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ABSTRACT
The literature supporting the use and efficacy of oral appliances in the management of obstructive sleep apnea (OSA) has grown enormously in the past two decades. The data gleaned from the study of many researchers and practitioners has led to the understanding of the better role of the oral appliances in managing patients with OSA. The aim of this article is to provide a brief review for OSA regarding its signs and symptoms, the risk factors, and a detailed description of the role of dentists and oral appliances in the treatment of OSA.

Keywords: Obstructive sleep apnea, Oral appliances, Signs and symptoms.

INTRODUCTION
Sleep-disordered breathing can be described as a spectrum of abnormal breathing during sleep that may range from primary snoring to hypopneas to periods of obstructive sleep apnea (OSA), during which there is complete cessation of breathing. Obstructive sleep apnea syndrome (OSAS) is characterized by recurrent episodes of partial or complete upper airway obstructions during sleep. It is the most common form of SDB. There is increasing evidence that OSA is an independent risk factor for an adverse cardiometabolic profile, and it has been associated with increased cardiovascular and cerebrovascular morbidity and mortality.

Obstructive sleep apnea is diagnosed using a combination of a sleep history, supporting questionnaires, a clinical examination of the upper airway, and overnight sleep monitoring. The gold standard diagnostic test for OSA is the overnight in-laboratory polysomnography.

Nasal continuous positive airway pressure (CPAP) has traditionally been the choice of treatment for moderate to severe OSA. Although nasal CPAP arguably remains a noninvasive treatment of choice, various oral appliances inundate the clinical field of treating mild to moderate OSA. Given compliance problems with nasal CPAP treatment, advancing the mandible forward to enlarge the pharynx could be considered an alternative to CPAP therapy. Orthognathic surgical intervention advances the mandible and the tongue base forward as do some oral appliances.

The purpose of oral appliances like mandibular advancement devices (MADS) is to increase the size of the pharyngeal airway or otherwise reduce its collapsibility and cause forward movement of the tongue.

Definition
Apnea is defined as a cessation of airflow for greater than 10 seconds with continued chest and abdominal effort.

Hypopnea is defined as a pathologic change during sleep wherein discrete episodes of reduced breathing are seen.

AHI Index: A common measurement of sleep apnea is the apnea-hypopnea index (AHI). This is an average that represents the combined number of apneas and hypopneas that occur per hour of sleep.

TYPES OF SLEEP APNEA
The pattern of apnea and hypopnea is obstructive, central, mixed, and complex.

- Obstructive sleep apnea is the condition in which there is an occlusion of the oropharyngeal airway for more than 10 seconds during sleep. There is continued or increasing respiratory effort throughout the event of breathing.
- Central sleep apnea is the condition in which the neural drive to all respiratory muscles is abolished resulting in apnea. There is transient loss of respiratory drive output from the central respiratory controller.
- Mixed apneas are individual events that begin as central apneas but become obstructive.
- Complex sleep apnea is the combination of pure obstructive and pure central events in the same patient during sleep.
ETIOLOGICAL FACTORS OF OSA

The various etiological causes of OSA can be summarized as:

- Anatomical malformations
  - Retrognathia
  - Congenital malformations
- Structural pharyngeal lesions
  - Enlarged tonsils and adenoids
  - Pharyngeal tumors
- Hormonal causes
  - Hypothyroidism
  - Menopause
- Neuromuscular weakness
- Obesity.

SIGNS AND SYMPTOMS

Signs and symptoms of OSA include:

- Sleepiness
- Loud snoring
- Choking or shortness of breath sensations during sleep
- Restless sleep
- Unrefreshing sleep
- Changes in personality
- Nocturia
- Abnormal cervicocraniofacial structures.

Are clearly a fundamental mechanism. Airway collapse ensues when dilator muscle activity and compensatory reflexes are no longer sufficient to maintain patency of the compromised airway.

Interventions for Sleep Apnea

- Behavioral
  - Weight loss
  - Avoidance of alcohol and sedatives
  - Avoidance of sleep deprivation
  - Nocturnal positioning
- Medical
  - First-line therapy
    - Positive pressure through a mask
  - Second-line therapy
    - Oral appliance
- Other
  - Fluoxetine
  - Thyroid hormone (in hypothyroid patients)
  - Nocturnal oxygen
- Surgical
  - Upper airway bypass
- Tracheostomy
  - Upper airway reconstruction
    - Uvulopalatopharyngoplasty
    - Genioglossal advancement
    - Maxillomandibular advancement

ORAL APPLIANCES

The use of oral appliances has involved dentists in the treatment of OSA among both adults and children. In the last few years, the use of oral appliances (provided primarily by dentist) for the treatment of OSA has become increasingly popular.

Case Selection

Patient should undergo a thorough dental examination to assess candidacy for OSA. Dental examination includes:

- Soft tissue examination
- Periodontal examination
- Temporomandibular joint and (TMJ) examination
- Signs of nocturnal bruxism
- Evaluation of occlusion
- Evaluation of orthopantomography (OPG) for dental pathology
- Cephalometric evaluation.

The Mechanism of Action of Oral Appliances

It is well known that airway narrowing is a normal physiological event that occurs during sleep. In patients with sleep apnea, this normal response is exaggerated. So a combination of abnormal anatomy and physiology is necessary to produce pathological repetitive narrowing (or complete occlusion) of upper airway during sleep (sleep apnea). Oral appliances may improve upper airway patency during sleep by:

- Enlarging the upper airway
- Decreasing upper airway collapsibility (e.g., improving upper airway muscle tone).

Oral Appliances used in the Treatment of OSA can be allocated into Three Groups based on their Mode of Action

1. Soft palate lifters

Soft Palate Lifters

These appliances act as scaffolding reaching back and supporting the soft palate. This reduces the vertical drooping of soft palate and uvula, and minimizes the fluttering effect and snoring noise (Fig. 1).

Mandibular Advancement Appliances

The main indication for the use of oral appliances in OSA cases is a case in which the patient chooses to have neither surgery nor CPAP. The most commonly used oral appliance nowadays is the mandibular advancement appliance that holds the mandible in a forward direction minimizing the upper airway collapse during sleep.
Based on the protrusion distance, mandibular advancement appliance can be of two types:
1. **Fixed**: The protrusion distance is constant.
2. **Variable**: The protrusion distance can be increased or decreased.

The different varieties of mandibular advancement appliance commonly used are as follows:
- Klearway oral appliance
- Adjustable PM positioner
- Thrompton adjustable positioner
- Herbst appliance
- Elastic mandibular advancement (EMA) appliance
- Modified monoblock.

**Klearway Oral Appliance**

Klearway is the most thoroughly researched oral appliance for the treatment of snoring and OSA (Fig. 2).

The advantages of the Klearway appliance (Fig. 3):
- Facilitates slow and gradual movement of jaw position by permitting the patient to adjust the appliance according to his or her own comfort level with the guidance of the attending dentist.
- Can be adjusted to over 44 positions, in increments of 0.25 mm.
- It is fabricated using thermoactive acrylic, which significantly decreases soft tissue and tooth discomfort.
- Permits lateral and vertical jaw movement, enabling patients to yawn, swallow, and drink water without dislodging the appliance.
- Provides full occlusal coverage of both arches.
- Does not encroach on tongue space.

**Adjustable PM Positioner**

The adjustable PM positioner was invented by Dr. Jonathan A. Parker. He developed this appliance to create a unique design that is durable, comfortable, and effective for patients.

It allows a small amount of jaw movement. Effectiveness of the device when it is indicated. This appliance is easy to use, effective, and durable.

**Thornton Adjustable Positioner**

The TAP holds the lower jaw in a forward position so that it does not fall open during the night and cause the airway to collapse. The TAP maintains a clear airway to reduce snoring and improve breathing.

**Indications**

- It is intended to reduce or alleviate night-time snoring and OSA.
- The appliance is for adult patients to be used when sleeping at home or in sleep laboratories and is for single-patient use.

**Contraindications**

- The device is contraindicated for patients with loose teeth, loose dental work, dentures, or other oral conditions which would be adversely affected by wearing dental appliances.
- In addition, the appliance is contraindicated for patients who have central sleep apnea, have severe respiratory disorders, or are under 18 years of age.

**How the TAP works**

The TAP holds the lower jaw in a forward position so that it does not shift nor fall open during the night. This prevents the airway from collapsing. Most patients experience relief the very first night they wear their TAP. Although it may take up to a week to get used to wearing a TAP appliance, this is a small hurdle for patients. Nine
oral appliances for the treatment of obstructive sleep apnea

in ten patients wear the device all night, every night – making the TAP a highly effective solution for both snoring and sleep apnea.

the herbst appliance

The Herbst appliance has been used for many years in the treatment of class II malocclusions in children. With minor modifications, the Herbst appliance has been proven to be effective in the treatment of snoring and mild to moderate OSA.

“Adjustability” is the primary advantage of the Herbst appliance in snoring and OSA cases. The post and sleeve mechanism advances the jaw into a forward position.

EMA appliance

It was developed by D Frantz for the treatment of OSA.

The device allows lateral, vertical, and anteroposterior movement of the mandible while advancing the mandible in a ventral and caudal direction. Elastic mandibular advancement significantly improves the polysomnographic severity of OSA.

Design Consideration

The oral device consists of two plastic trays custom-molded to the patient’s maxillary and mandibular teeth.

• The amount of bite opening was just sufficient to allow clearance of the upper and lower incisors during mandibular advancement.
• To activate the appliance, elastic straps are attached to the right and left pairs of button hooks so that the stationary maxilla pulls the mandible forward. The amount of mandibular advancement can be adjusted by varying the length and elasticity of the straps connecting the upper and lower dental trays (Fig. 4).

Advantages

• The comfort of EMA should enhance the compliance of patients in using the device on a nightly basis.
• Portability.

Conclusion

The etiology of OSA is multifactorial in nature. It includes age, gender, ethnicity, anatomical abnormalities which are nonmodifiable in nature. The most important modifiable risk factor is obesity.

Common symptoms seen in patients with OSA include excessive daytime sleepiness, loud snoring, choking, nocturia, etc. Cephalometric radiographs are very frequently used as a method of diagnosis for OSA.

Obstructive sleep apnea can be treated by surgical as well as nonsurgical procedures. The nonsurgical methods include behavioral modifications like weight loss, avoidance of alcohol and sedatives, nocturnal positioning, etc. Positive pressure through a mask is considered as the first line of medical treatment. Oral appliance therapy is considered as the second-line therapy. The most commonly used oral appliances are the mandibular advancement appliances.

Obstructive sleep apnea is a leading public health problem both in the developed and developing nations. However, awareness regarding diagnostic options, management, and consequences of untreated OSA remains inadequate. In developing nations, the resources for adequate sleep medicine facilities are scarce. Therefore, there is a need for low-cost, simple, and accurate diagnostic and therapeutic modalities.

References