

REVIEW ARTICLE

OBSTRUCTIVE SLEEP APNEA AND ITS MANAGEMENT- A REVIEW

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ABSTRACT:

Obstructive sleep apnea [OSA] is an increasingly common disorder. It is caused by partial or complete obstruction of the upper airway during sleep that results in absent or diminished airflow in lungs. The treatment modalities consist of both surgical & nonsurgical methods. Various dental appliances are used increasingly in mild snoring as an alternative to surgery. This article reviews the anatomic features and etiologic factors of OSA and diagnosis and possible treatment options specially on oral appliances in management of this disorder.

Key words: - Obstructive sleep apnea, Diagnosis, Management, Appliances

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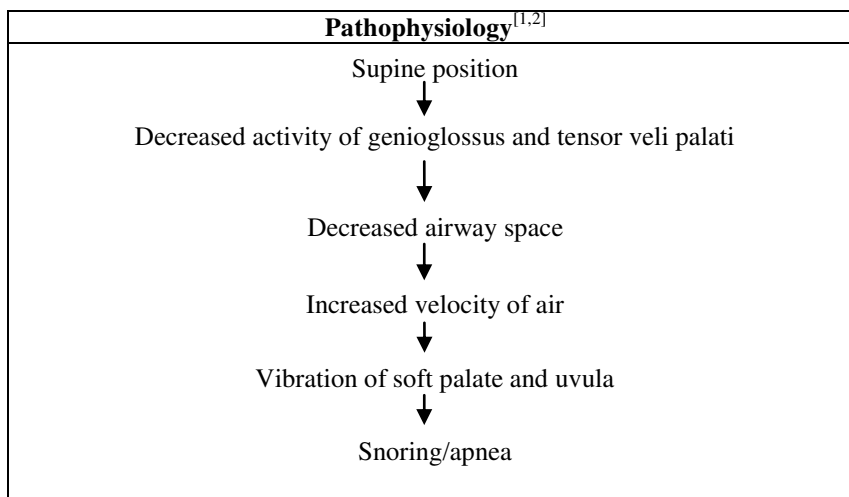
INTRODUCTION

Obstructive Sleep Apnea [OSA] is typified by the periodic collapse of the upper airway during sleep and results in absent airflow [apnea] or diminished airflow [hypopnea] into the lungs despite persistent inspiratory effort. This, in turn, cause repetitive arousal from sleep to restore airway patency, which may result in daytime hypersomnolence or other daytime manifestations of disrupted sleep such as aggressive or distractible behaviour in children.

There are various causes that cause snoring such as normal snoring - many people snore without any medical condition, Aging, Sleep-disordered breathing, Sleep apnea, Obstructive sleep apnea, Overweight, Obesity, Tonsillitis, Adenoiditis, Stuffy nose - and various cause of nasal stuffiness: Common cold & Allergies. One of the major causes of snoring is Obstructive sleep apnea.^[1]

PATHOPHYSIOLOGY

Table 1: Pathophysiology of OSA



ASSESSMENT AND CLASSIFICATION [2, 3]

The frequency of apneas and hypopneas hourly is used to assess the severity of the OSAHS and is called the apnea/hypopnea index [AHI] or the respiratory disturbance index [RDI]. It is unclear if it is the best measure of this disorder but it is the one most commonly used. Other measures including oximetry, computerized EEG analysis, autonomic arousal detection or body movement analysis, may be equally as good at characterizing the severity of sleep apnea.

OSA is classified on the basis of Apnea-Hypopnea Index [AHI] or Respiratory- Disturbance Index [RDI] i.e. total number of apneic and hypopneic episodes per hour. It was given by *McNamara et al.* An RDI of 0 to 5 is normal; 5 to 20 is mild; 20 to 40 is moderate and over 40 is considered severe.

TYPES OF APNEA [3]

- a) **Obstructive sleep apnea:** It is the most common type of sleep apnea which occurs due to cessation of airflow due to a total airway collapse.
- b) **Central sleep apnea:** Much less common than OSA that occur due to lack of Central nervous system stimulation to respiratory muscles
- c) **Mixed sleep apnea**

ETIOLOGY [2, 4, 6]

Possible etiological factors have been proposed and listed in Table 2

SIGNS AND SYMPTOMS- various signs and symptoms observed in patients with OSA are presented in Table 3

Table 2: Etiology

Anatomical Factors	Behavioural Factors	Other Factors
<ul style="list-style-type: none"> • Small sized mandible • Too large or too long tongue • Long Soft Palate/uvula • Tonsillitis, enlarged adenoids • Muscle weakness due to old age or disease • Nasal deformity 	<ul style="list-style-type: none"> • Obesity → causing deposition of fat in pharyngeal wall • Sleeping on one's back 	<ul style="list-style-type: none"> • Smoking, Alcohol, CNS depressants, Sedative, Allergy, asthma, cold or sinus infection

Table 3- Signs and Symptoms [3,4,6,8]

- excessive daytime sleepiness
- impaired concentration
- snoring
- unrefreshing sleep
- choking episodes during sleep
- witnessed apnoeas
- restless sleep
- irritability / personality change
- nocturia
- decreased libido
- morning headache
- high blood pressure
- rapid weight gain

Diagnosis [1, 4, 5, 6, 8]

- Physical examination and interview
- ENT examination and radiograph
- Epworth sleepiness scale [ESS]- Determine level of daytime sleepiness
- Polysomnography [PSG] - Gold standard to evaluate the sleep and breathing pattern. PSG can determine the existence, type and severity of any apnea disorder.

TREATMENT [2, 4, 7, 9, 14]

- **Non surgical-** Behavioral modifications
Medications
Nasal continuous positive air pressure [NCPAP] [17, 18, 21]
Removable dental appliances

- **Surgical intervention-** Tracheostomy
Maxillomandibular advancement osteotomy

Uvulopalatopharyngoplasty [UPPP]
Tonsillectomy and adenoidectomy

REMOVABLE DENTAL APPLIANCES- Dental appliances may prevent snoring and OSA by modifying the position of the upper airway structures so as to enlarge and/or reduce collapsibility of the airway. [4, 9, 10, 11, 16] These appliances can reposition the tissues by lifting up the soft palate, bringing the tongue forward, or lifting the hyoid bone. As they reposition, some appliances also stabilize these tissues, preventing airway collapse. Appliances can also increase muscle tone. Specifically, there is an increase in pharyngeal and genioglossus muscle activity

Historical aspects of oral appliances

Oral appliances were originally derived from an orthodontic functional appliance, the Esmarch appliance, as proposed by **Meyer-Ewert and Brosik**. **George Cattlin** was probably the first person who seriously thought that the route of breathing may influence sleep quality and daytime function. He pointed out that breathing through the nose promotes more restful and better quality sleep, which translates into better daytime function and better general health. However, modern published clinical work began in 1903, when **Pierre Robin** first described a device, called the “**monoblock**”, for the treatment of glossoptosis. It took almost another 50 years to start using oral appliances for the treatment of snoring and sleep apnea when **Cartwright and Samelson** described the tongue retaining device in 1982. This work stimulated further investigations. Of the several appliances available in the market today, more than 34 have been accepted by the American Food and Drug Administration for intraoral use in the treatment of obstructive sleep apnea.

Indications

- Mild snoring.
- Non compliance of patient to NCPAP.
- Surgery contraindicated.

- Cases of mild/moderate apnea.
- Mandibular retrognathia.

Contraindications

- Complete blockage of nasal pathway.
- Central sleep apneas
- Severe periodontal disease
- Existing TMJ disorder
- Painful masseter muscle
- Severe OSA
- Growing children
- Mouth opening less than 30 mm
- Severe hypoxemia
- Unmotivated patients

Advantages

- Good patient tolerance and compliance.
- Non invasive.
- Relatively small and easy to wear.

Disadvantages of oral appliances [6, 11]

The advancement of the mandible or tongue, being the principal mechanism of action of oral appliances, has the potential to cause adverse effects too. Mandibular advancement splints generate reciprocal forces on the teeth and jaw that can result in acute symptoms, as well as long-term dental and skeletal changes.

Short-term adverse effects

- Excessive salivation
- Mouth dryness
- Tooth pain
- Gingival and oral mucosal irritation
- Headaches
- Temporomandibular joint discomfort
- Mouth sores
- Periodontal complications
- Ingestion of broken appliance

Long-term adverse effects

- Reduction in overjet
- Increase in facial height
- Increase in degree of mouth opening
- Changes in inclination of incisors
- Increase in mandibular plane angle
- Root resorption

TYPES OF ORAL APPLIANCES

There is abundant variety of appliances available and all these oral appliances may be divided into three general groups: Soft palate lifters [SPLs], Tongue retaining or repositioning devices [TRDs], and Mandibular advancement devices [MADs] also known

as Mandibular advancement appliances [MAA] or Mandibular advancement splints.

CRITERIA OF EVALUATION OF ORAL APPLIANCES^[12]

1. Reliability at stopping snoring
2. Titratability
3. Simplicity of delivery
4. Low bulk
5. Lip seal
6. Tongue space
7. Non-interference with sleep
8. TMJ or tongue symptoms easily adjusted
9. Low cost
10. Lateral freedom

SOFT PALATAL LIFTERS^[2, 14]

Soft palate lifter lifts and/or stabilizes the soft palate preventing vibration during sleep. These appliances are virtually no longer in use today most likely because of gag, discomfort, and the success of laser and radio frequency soft-palate procedures.

TONGUE RETAINING DEVICES; First described by *Cartwright and Samelson*.

The Tongue Retaining Device [TRD] is a custom-made appliance with an anterior bulb that holds the tongue in a forward position during sleep by means of negative suction pressure. By holding the tongue in forward direction through its attachment to genial tubercle, it stabilizes the mandible and hyoid bone, thus preventing the retrolapse of tongue. It is most useful in patients with very large tongue, poor dental health, no teeth, and chronic joint pain or in people where sleep apnea worsen on lying on their back or side. The device cannot be used in people who are tongue tied, overweight, and cannot breathe through their nose.^[2, 9, 20, 25]

MANDIBULAR ADVANCEMENT DEVICES^[9, 16, 22, 29]

first described by *Robin* in 1934. The mandibular advancers may be made of elastomeric material or hard acrylic, or thermoplastic. Their retention on the teeth can be provided by friction fit of plastic in undercuts, which is most common, or by clasps

Mandibular advancement appliances are either one-piece [monobloc] or two-piece [duobloc] configuration. The former may be a simple vacuum formed splints with upper and lower fused together or clasped acrylic appliances, for example snore-guard, SNOAR etc. Two piece splints, where upper and lower elements are connected by rigid or plastic lateral connectors, allow some freedom of mandibular movement, for example Silencer, Herbst, Restore

Mechanism of action- Protrudes the mandible thereby increases anteroposterior dimension of airway space. The amount of forward repositioning and vertical opening varies with the appliance, the clinician and also the comfort on part of the patient. The tongue is also advanced passively because of its attachment to the genial tubercles. These devices simultaneously move the soft palate anteriorly because of its attachment to the tongue via the palatoglossus muscle. These movements enlarge the hypopharyngeal airway and reduce the likelihood that the tongue or soft palate collapses against the posterior pharyngeal wall when the patient inspires during sleep.^[11]

TYPES

1. Silencer system^[9, 11, 14]

Introduced in 1998. Utilizes a custom fitted upper and lower splint which incorporates the Halstrom Hinge titanium precision attachment at the incisor level allowing sequential 2mm advancements up to 8mm, lateral movement of 6 mm. It is the only appliance that allow adjustments not only in front and back position but also in open and close position. A flat posterior bite plane is provided for the biting surfaces. Most expensive because of use of titanium.

2. The Thornton Adjustable Positioner [TAP]^[9, 14, 26]

Described by Dr W. Keith Thornton. It connects the upper and lower splint with a single hook and latch in the anterior region. Its lingual hook mechanism is bothersome to the tongue, and its titration knob protruded out the lip. Allows progressive 0.25 mm advancements of the jaw via anterior screw mechanisms at the labial aspect of the upper splint. This appliance has separate action for maxilla and mandible. This is easily retained by bruxers and who have worn teeth. As mentioned the front assembly is located near the tip of the tongue and it protrudes between the lips, so it may take a little bit more time to adapt to the device. However, most patients find it to be comfortable within the first 5-10 days.

3. Adjustable PM Positioner^[9, 11, 14]

The PM positioned links the upper and lower splints with the bilateral orthodontic expanders. The appliance is comfortable on the teeth and leaves added space for the tongue compared to other devices. It allows a small amount of jaw movement (4mm) so that the patient does not feel "locked into position". Good choice for moderate OSA cases requiring firm retention during greater mandibular advancement. Unique mode of

retention by small projection of acrylic with in the device. So no metal clasps are necessary.

4. Klearway Oral Appliance ^[9, 11, 14, 20]

The Klearway oral appliance utilizes a maxillary orthodontic expander to sequentially move the mandible forward. It is a fully adjustable oral appliances used to treat mild to moderate obstructive sleep apnea made of thermoactive acrylics. Small increments of mandibular advancement are initiated by the patient and this prevents rapid jaw movements that cause significant patient discomfort. Lateral and vertical jaw movements are permitted the patient to yawn, swallow and drink water without dislodging appliance.

5. Modified Herbst Appliance ^[11, 12, 14, 31]

This is a hard plastic appliance which has the adjustment hardware set on the cheek side of the molar teeth. It prevents side-to-side motion, but since the bottom jaw is held closed with small orthodontic rubber bands, opening the jaws is fairly easy. The modified Herbst is smaller than most appliances and has a long life span. It allows jaw movement in all directions but backwards. The patient can take medications, use an asthma inhaler or talk with this appliance in place. This appliance can be fabricated out of material that has no methylmethacrylate and is thus safe for patients who are allergic to this material. Patients who severely grind their teeth at night can crack this appliance.

6. Elastic Mandibular Appliance (EMA) ^[11, 12, 32,33]

The E.M.A. is the thinnest and least bulky of all the appliances. It is similar to clear acrylic orthodontic retainers, and the 'hardware' (located to the cheek side of the molar teeth) consists of specially designed, patented elastic bands. This appliance moves the jaw forward in fairly significant steps, which may be difficult to tolerate. Some care must be taken to avoid breaking the lower portion when replacing the custom elastics. The EMA is well tolerated by patients who grind their teeth. It has no metal and can be used by patients with a nickel metal allergy

ORAL PRESSURE APPLIANCE

It is a combination therapy which combines a non adjustable mandibular repositioning device with continuous positive airway pressure [nasal CPAP]

In this appliance the air pressure is delivered through a small conduit that fits across the roof of patient's mouth. Thus it is more effective than CPAP and can be used by patients without need to wear nasal mask, have elastic straps around head, or sleep on one's back.

CONCLUSION

All patients with clinically significant OSA have a multifactorial aetiology, rather than any single causative factor. However, these factors, such as defects in ventilatory control and protective upper airway reflexes, are less easily defined and further research is needed to elucidate their precise role in maintaining upper airway patency during sleep. A better understanding of the interacting factors that lead to the development of clinically significant OSA will, hopefully, lead to the development of simpler modalities of therapy.

Oral appliance would be suitable first line therapy for simple snoring and mild OSA and alternative therapy in more severe cases when NCPAP was not accepted and surgery was not indicated.

OSAs are potentially life threatening medical problems, and therefore all patients must be referred to a physician to diagnose its severity prior to insertion of any oral device.

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