Short Communication

Obstructive sleep apnea in orthodontics: An overview

ABSTRACT

Obstructive sleep apnea (OSA) is characterized by the cessation of air flow during sleep due to an obstruction in the nasopharyngeal/oropharyngeal region. Many episodes of apnea may take place within a span of minutes leading to arousal of the patient from his/her sleep in an attempt to increase the amount of air flow. Apart from inadequate hours of sleep, this also results in a deteriorated quality of sleep. Sleep apnea can be caused due to many factors and many treatment modalities have been employed to correct this disorder including mandibular advancement appliances, polysomnographs, and surgical intervention. Best results, however, have been seen with the use of the mandibular advancement appliances. This article highlights the role the orthodontist plays in the diagnosis and treatment planning of OSA patients.

Key words: Etiology; mandibular advancement appliances; obstructive sleep apnea.

Introduction

Sleep apnea is defined as an intermittent cessation of airflow at the nose and mouth during sleep. By convention, apneas of at least 10 s duration have been considered important, but in most patients, they are 15–20 s in length and may last as long as 1–3 min.[1-3] It can be classified as follows:[4]

- Central sleep apnea – Nerve impulse to all respiratory muscles is absent
- Obstructive sleep apnea (OSA) – Occlusion of oropharyngeal airway is seen. OSA affects 2–4% of middle-aged adults
- Mixed apnea – Central apnea followed by obstructive component.

Obstruction of airflow results in a reduction of blood oxygen saturation known as hypoxemia. It produces arousal in an attempt to reopen the airway, due to which the quality of sleep diminishes. This, in turn, results in greatly diminished productivity, time wasting, day dreaming, impaired cognition, increased accident rates, and various other medical disorders that impact every aspect of life.[5,6]

Normal Sleep Architecture

Normal sleep is characterized by silent neurological patterns that show different stages of sleep.[7] Normal sleep architecture is characterized by two forms, namely nonrapid eye movement (NREM) and rapid eye movement (REM).[8,9] Sleep is initiated in Stage 1 NREM and progressively moves through the deeper Stages 2, 3, and 4 before reaching REM sleep.[10] REM sleep is associated with vivid dreaming and diminished tone of the skeletal muscles of the pharyngeal space and limbs. During NREM sleep, breathing frequency and aspiratory flow rate are reduced with minute ventilation falls. In the deepest stage of NREM sleep (Stage 4), breathing is slow,

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deep, and very regular. However, in Stages 1 and 2, the depth of breathing sometimes varies periodically. The explanation is that in light sleep, removal of the wakefulness stimulus varies over time in a periodic fashion: When removed, sleep is deeper and breathing is depressed. When returned to normal, breathing is excited not only by the wakefulness stimulus but also by the carbon dioxide gas which was retained during the interval of sleep. This pattern of breathing is known as Cheyne–Stokes respiration [Figure 1].[11]

Pathogenesis of Obstructive Sleep Apnea

The definitive event in OSA is occlusion of the upper airway space, usually at the level of the oropharynx.[12] The resulting apnea leads to progressive asphyxia until there is a brief arousal from sleep, whereupon airway patency is restored and airflow resumes. The patient then returns to normal sleep, and this cycle of events is repeated. The immediate factor leading to collapse of the upper airway in OSA is the production of critical sub-atmospheric pressure during inspiration that exceeds the potential of the airway dilator and abductor muscles to maintain airway stability. Obesity frequently contributes to the reduction in the size of upper airway, either by increasing fat deposition in the soft tissues around the pharyngeal airway or by compressing the pharynx by superficial fat masses in the neck. Snoring, a high-frequency vibration of the palatal and pharyngeal soft tissues that results from the decrease in size of the upper airway lumen, may aggravate the narrowing by producing edema of the soft tissues.[13-16]

Etiology

- Obesity
- Adenotonsillar hypertrophy
- Mandibular deficiency
- Macroglossia
- Upper airway tumors (rare)

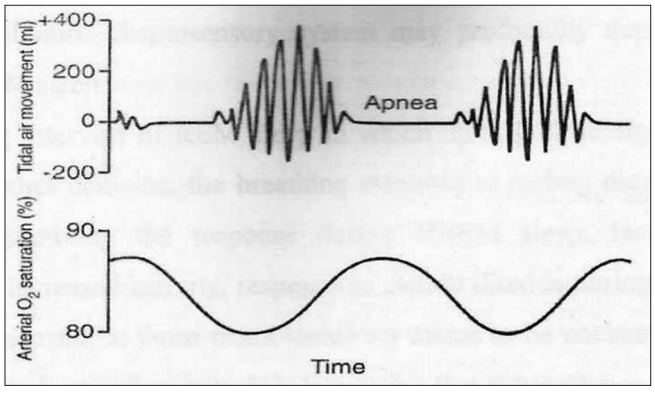

Figure 1: Cheyne–Stokes respiration

- Loss of muscle tone
- Obstruction of nasal passages
- Alcohol
- Sedative medications.

Symptoms

- Loud snoring
- Behavioral disturbances
- Fragmentation of sleep
- Nocturnal cerebral hypoxia
- Excessive day time sleepiness
- Intellectual impairment
- Memory loss
- Impotence in men.

Methods of Assessing the Degree of Respiratory Obstruction

The methods are thorough history and physical examination:

- Sleeping habits
- Snoring
- Mouth breathing
- Hypersomnia
- Headaches
- Lethargy
- Weight gain
- Difficulty in awakening.

Physical examination of the head, neck, chest, and abdomen areas.

Diagnosis

The diagnosis is made by the following ways:

- Sleep history
- Epworth sleepiness scale questionnaire
- Apnea hypopnea index (AHI)
- Polysomnography (PSG).

Of the above methods, PSG plays a vital role in the diagnosis of sleep apnea.

Polysomnography

It is the golden standard for the diagnosis of sleep apnea and other sleep disorders. It involves an overnight sleep in the laboratory with multichannel monitoring or multiple physiologic variables in the presence of a technician throughout the study. During the study, sleep stages and sleep continuity, respiratory effort, airflow, oxygen saturation, body position, electrocardiogram, and movements are recorded.[17,18]

Treatment

General measures:
- Weight control
- Avoidance of alcohol and sedatives
- Sleep position
- Sleep apnea, no driving and operation of heavy equipment.

Specific measures:
- Nasal continuous positive airway pressure
- Mandibular advancement appliances and removable appliances.

Surgical measures:
- Uvuloplasty
- Midline glossectomy
- Maxillomandibular osteotomy and advancement.

Mandibular Advancement Appliances

The ideal properties of removable appliances include simplicity of delivery, low bulk, lip seal maintenance, sufficient tongue space, noninterference with sleep, low cost, and lateral freedom. The patients selected for these types of appliances need to have certain features for the appliance to exhibit the best possible results. These include reduced lower anterior facial proportions, normal relation between maxilla and mandible, high position of hyoid, normal soft palate area and tongue proportion, and relatively normal postpalatal and postlingual airway.[18] Advancement appliances are manufactured in different materials and sold under different trade names. Their main purpose is to place the mandible in a forward position so that the size of the airway passage is increased [Figure 2].

Kyung *et al.*[19] measured the pharyngeal size and shape differences between pre- and post-trials of a mandible-protruding oral appliance using cine computerized tomography. They found that the oral appliances appeared to enlarge the pharynx to a greater degree in the lateral than in the sagittal plane at the retropalatal and retroglossal levels of the pharynx, thus suggesting a mechanism for the effectiveness of oral appliances that protrude the mandible. Ngiam and Kyung[20] investigated the efficacy of orthodontic microimplant-based mandibular advancement treatments for the treatment of severe snoring and OSA in adult patients [Figure 3].

They found that favorable reductions in sleep variables highlight the potential of microimplant-based mandibular advancement therapy as an alternative treatment modality for OSA patients who cannot handle the continuous positive airway pressure and oral appliance therapy. Referring to these studies, it is clear that the advancement appliances have given very favorable results in the treatment of OSA.

Conclusion

The selection of patients, suitable for oral appliance therapy, must always be made by the attending physician. After which, the dentist selects the appropriate oral appliance. Mandibular advancement appliances are effective in changing the three-dimensional size of airway tube. Oral appliances have an effect on the tongue muscles by advancing the mandible, holding the tongue forward, or changing its vertical position, thus affecting the baseline tongue activity. If oral appliances simply rotate the mandible down and back, they will predispose to constriction of the hypopharynx due to which OSA may worsen. Allergic and nasal obstructions may sometimes prove to be contraindications in this line of treatment for OSA patients. If the initial assessment is coordinated by the attending physician and good communication is made with the dentist involved, a significant number of patients with snoring or mild-to-moderate OSA can

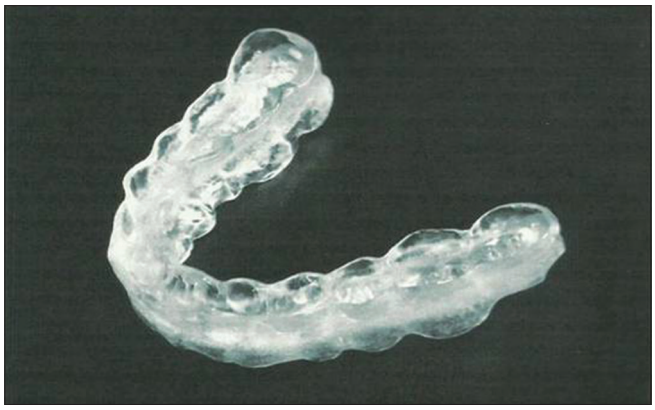

Figure 2: Mandibular advancement appliance

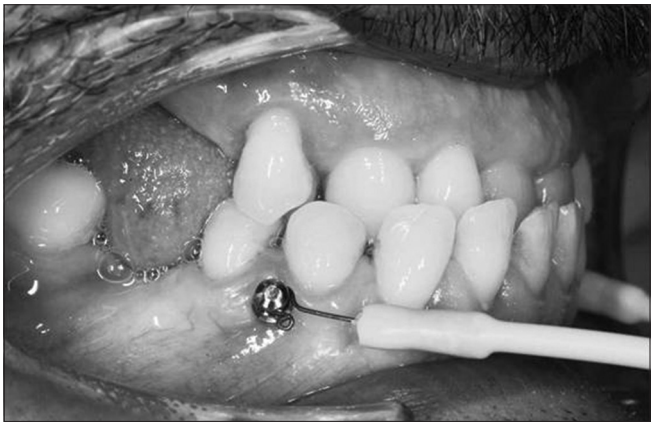

Figure 3: Microimplants for the advancement of the mandible

be treated successfully with oral appliances. Oral appliances appear to be an effective nonsurgical alternatives for many individuals with either snoring alone or mild OSA. There is, however, concern over the long-term adverse effects, especially anterior flaring of mandibular incisors and canine teeth and the promotion of temporomandibular joint disorders. An adjustable mandibular repositioning appliance fitted to a few maxillary and mandibular teeth proves to be effective in reducing the AHI as well as snoring and increasing the saturated oxygen and REM stage during sleep.

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Conflicts of interest
There are no conflicts of interest.

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