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Obstructive sleep apnea Orthodontic perspective: A Review

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Abstract

Obstructive sleep apnea (OSA) is a common sleep associated breathing disorder with profound effects on the health and quality of life of individuals suffering from it. Orthodontists should be well aware of the symptoms of this disorder and competent enough to recognize its signs and symptoms. Orthodontists are well suited for treatment of OSA patients due to their expertise and knowledge regarding growth and development of orofacial and dento-facial structures as well as orthopedic, orthodontic and surgical correction of the jaws and other supporting tissues. The aim of this article is to provide an outlook to the essential role of Orthodontists in the treatment of this serious disease.

Keywords: Obstructive sleep apnea; Orthodontics; Mandibular advancement appliance.

Introduction

The specialty of orthodontics involves much more than just moving teeth and the management of sleep apnea bears witness to this. The role of the orthodontist both in screening for obstructive sleep apnea (OSA) and as a practitioner who is valuable in the multidisciplinary management of OSA in both children and adults. While OSA can only be definitively diagnosed by a physician, the orthodontist may be called on to screen for OSA, contribute to the identification of underlying dentofacial components and assist the physician in managing the disease.[1]

Obstructive sleep apnea (OSA) is an increasingly common, chronic, sleep-related breathing disorder[2].OSA is characterized by periodic narrowing and obstruction of the pharyngeal airway during sleep. Untreated OSA is associated with long-term health consequences including cardiovascular disease, metabolic disorders, cognitive impairment and depression[3-4]. Common symptoms include excessive daytime sleepiness, fatigue, non-refreshing sleep, nocturia, morning headache, irritability and memory loss[5-7]. Untreated OSA is also associated with lost productivity in workplace and motor vehicle accidents resulting in injury and fatality.[8]

OSA Pathophysiology

Sleep-disordered breathing is divided into so-called “central” events, denoting an absence or marked reduction in central respiratory motor output to respiratory pump muscles, or “obstructive” events, which are comprised of respiratory efforts against a closed upper airway.[9] Upper

airway obstruction in sleep is most prevalent in humans because the hyoid bone, a key anchoring site for pharyngeal dilator muscles, is not rigidly attached to skeletal structures.[10] The upper airways collapse more easily in OSA patients and occurs at slightly negative intra-thoracic pressures or even positive pressures.[11]

Narrowing can occur in more than one site. The retropalatal or velopharyngeal region is the most common site; but the collapse usually extends to other locations. Since REM sleep is associated with greater muscle hypotonia compared to non-REM sleep, sleep-breathing disorder is more likely to occur during REM sleep.[12] In addition, the sleep-awake state in the pathogenesis of OSA is important to highlight. OSA patients, even with the most severe apnea, have generally no respiratory dysfunction during wakefulness through compensatory systems.[13]Tongue shape in patients with Obstructive sleep apnea syndrome (OSAS) is different from that of normal subjects in the supine position. Tongue shape therefore may be taken to play an important role in the development of OSAS.[14]

Altered upper airway anatomy, conditioned by skeletal abnormalities as in Pierre Robin syndrome[15], or by alterations of the soft tissues of the neck, particularly in obese patients, with increased adipose tissue in the region of the neck with fat infiltration and edema in the soft palate are also implicated in this syndrome. Although obesity is regarded as a principal risk factor in the occurrence of OSAS, it has been shown that the neck perimeter is more closely correlated to severity of the syndrome than body mass index, though there is usually direct proportionality between obesity and neck perimeter.[16]

Diagnosis

An essential requirement for a correct diagnosis of OSAS is a correct anamnesis, recording the family history (history of OSAS) and personal antecedents (tonsillectomy/adenoidectomy in childhood, alcohol intake, the use of muscle relaxant drugs, obesity, etc.). It is also important to establish the profession of the patient, since in some professions OSAS constitutes a medical emergency[17].A proper physical examination is also required (height, weight, body mass index, cardiovascular evaluation), including exploration of the upper airway (nasal passages, oropharynx and hypopharynx and larynx).[18]

The above data in turn should be complemented by radiological study in the form of either conventional lateral X-rays[19] or 3-dimensional X-ray study[20], which will reveal the craniofacial anatomical alterations predisposing to OSAS [21].

Many tests are available for evaluating sleep and for diagnosing OSAS. The most widely used technique is polysomnography (PSG)[22], which monitors the sleeping state, respiration, electrocardiogram, movements of the legs, oximetry and snoring. In addition, PSG records the distribution of the stages of sleep, the number of awakenings, the number of apneas or hypopneas, the starting time of sleep and the hours of efficient sleep (hours asleep/hours in bed). PSG also provides the apnea / hypopnea index (AHI); in this context, apnea is very serious and can only be treated surgically when AHI >30, while AHI 15-30 defines moderate apnea, and an AHI score of < 15 indicates mild apnea.

While PGS provides a lot of information, it is a complex and expensive technique – this limiting its practical applicability to the evaluation and treatment of OSAS. For this reason, simple tests have been developed and are now used in many healthcare systems. While such techniques provide less information, they are cheaper and can be applied in the home of the patient [23].

Management of OSA

Treatment of Obstructive sleep apnea can be divided into four general categories. These include: lifestyle

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modification, Continuous positive air pressure (CPAP), oral appliances and upper airway surgery [24-25].

Lifestyle modification

Obesity results in fatty deposits around the neck, which contribute to pharyngeal collapse. Sleeping in the supine position compared with the lateral position may double the apnea-hypopnea index in patients with OSA This can be overcome by lifestyle modification such as i.e. weight loss, cessation of evening alcohol ingestion, sleep position.[24]

Continuous positive air pressure

Continuous positive airway pressure (CPAP) therapy, first introduced by Sullivan et al. in 1984 remains the gold standard treatment of choice. CPAP device is currently considered to be the first-line treatment for OSA in adults [26]. CPAP works via pneumatic splinting of the upper air-ways. Airway pressure may be applied through oral, oro-nasal, and nasal devices. When used properly, CPAP treatment is efficacious at reducing both subjective symptoms of OSA and cardiovascular risk [27,28]. However, CPAP efficacy is limited by highly variable patient compliance to therapy. In the literature, the reported adherence to CPAP ranges from 30 to 70 % .[26,29] Thus, a significant number of patients ultimately abandon CPAP therapy. For patients who are intolerant to CPAP, physicians must consider other treatment modalities.

Oral appliance

The oral appliances are divided into three general groups: soft palate lifters (SPL), tongue retaining devices (TRD), and mandibular advancement appliances (MAA). The first category is virtually no longer in use today. The second category is used very seldom, mainly if there are dental reasons precluding the construction of MAA. The last category (MAA) is by far the most common type of dental appliance in use today. It protrudes the mandible forward, thus preventing or minimizing upper airway collapse during sleep. These devices can either be fixed (i.e. the protrusion distance cannot be changed) or variable (i.e. protrusion can be increased or decreased).[30]

Mechanism of action of oral appliances

The upper airway obstruction during sleep may occur at any site between the nasopharynx and the larynx. The most common sites of obstruction are behind the base of the tongue (retroglossal) and behind the soft palate (retropalatal). This partial or complete occlusion of the upper airway during sleep is a consequence of abnormal anatomy and physiology[31,32]. Advancing the mandible forward can enlarge the airway and reduce pharyngeal collapsibility[33] in normal subjects and patients with sleep apnea[34].The anatomical changes in the oropharynx, produced by mandibular advancement, result in the alterations of the intricate relationships between different muscle groups controlling the upper airway caliber. In some patients with sleep apnea these alterations may prevent the obstruction, in others worsen the obstruction and yet in others, particularly in those with low level obstruction, the part of the airway where the obstruction occurs may be unaffected[35,36].

Mandibular advancement appliances (MAA)

MAA is the most common type of intra oral appliance used for the management of OSA. It protrudes the mandible forward, thus preventing the upper airway collapse during sleep. The appliance has to be worn only during sleep and it helps to keep the airway open by repositioning the mandible, tongue, soft palate and uvula.[37] Currently three categories of appliances are available.[38] figure 1

I. **First category**: One-piece appliance which does not have the ability to advance the mandible incrementally

II. **Second category:** Two piece in design and the appliance has the potential for the incremental advancement of mandible.

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III. Third category: This appliance design allows the incremental advancing of mandible as well the lateral movement of mandible.[39,40]

Figure 1, Various mandibular advancement appliance. a) Modified twin Block appliance b) Klearway Splint c) Herbst Advancement Splint.

Advantages

1. Wearing of oral appliances results in significant reduction of apnea in patients with mild to moderate OSA.In patients with severe OSA, airflow improvement is satisfactory.
2. Compared with CPAP which use complex setup, intra oral appliances are well accepted by the patients.
3. It is easy to use compared to CPAP and also it is easily portable which makes the patients more compliant with this treatment modality.[41]

Disadvantages

1. Mandibular advancement appliances exert reciprocal forces on the dentition which will result in the development of acute symptoms and also long term skeletal and dental side effects.
2. Long term usage of the mandibular advancement appliance also results in the development of temporomandibular joint symptoms.
3. The acclimatization period mild and self-limiting side effects can develope like excessive salivation, mouth dryness, tooth pain, gum irritation, headaches and temporomandibular discomfort.[42,43]

Upper Airway surgery

Surgery is considered when noninvasive therapy such as CPAP and oral appliances has been not successful. It is done in a situation when there is any deformity in an atomic structure that can be later on corrected to eliminate the breathing problems. It addresses the problem by reduction of tissue from the soft palate, uvula, tonsils, adenoids or tongue.

Many different surgical approaches have been used in the treatment of Obstructive sleep apnea-hypopnea syndrome.

Uvulopalatopharyngoplasty (UPPP): It is the reconstruction of the throat by resection of the posterior margins of the soft palate and unwanted mucosa present on the pharyngeal walls.[44]

Adenotonsillectomy: It is the surgical removal of the tonsils and adenoids and it is the most common treatment option for children with OSA.

Tracheostomy: Tracheostomy was the first surgical treatment for OSAHS and bypasses the obstruction completely.[45]

Other surgical techniques

- **Bariatric (weight reducing) surgery:** Weight influences the severity of OSAHS and weight loss is an effective treatment for OSAHS in some patients.[46]
- **Nasal surgery:** Nasal surgery reduces nasal airflow resistance and reduces pressure and improves compliance with nasal CPAP [47].

Conclusion

The etiology of OSA is multifactorial, consisting of a complex interplay between anatomic and neuromuscular factors, causing a tendency for upper airway collapse. The effects of untreated sleep apnea on daily activities are multiple and it includes excessive daytime sleepiness, impaired cognitive function, mood elevations and personality changes. It is also related with a reduction in quality of life and there can be adverse changes on others such as impaired relationships between spouses and partners. Symptoms of sleepiness is observed in sleep apnea and these disorders need to be treated urgently. If OSA is suspected after proper history taking and clinical examination, a medical consultation is recommended and

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the patient can be managed with thorough interdisciplinary discussions and treatment planning. Orthodontists should play an active role in screening of patients for this disease and advise oral appliance therapy, if requires.

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