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Oral appliances in the treatment of obstructive sleep apnea syndrome

Oralni aparati za lečenje sindroma prekida disanja tokom spavanja

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Ključne reči:
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Introduction

Obstructive sleep apnea (OSA) is the most common respiratory sleep disorder in clinical practice. It occurs as a result of decreased muscle tone in the musculature that dilates the pharynges, and is especially manifested during sleep. Sleep apnea/hypopnea syndrome is described as the occurrence of a minimum of five interruptions in breathing and/or the decrease in ventilation during one hour of sleeping apnea/hypopnea index (AHI) with the existence of daytime and night-time difficulties [1, 2]. Daytime symptoms present with excessive daytime sleepiness, difficulty in concentrating, loss of movements coordination, the feeling of fatigue and exhaustion, impotence, mood disorders like depression, which altogether not only interferes with normal daily functioning and working abilities, but also increases risk of car accident and occupational injury [3]. Night-time symptoms usually are observed by family members of the one suffering from OSA, first of all apneas during sleep and snoring, which can exceed 90 dB in intensity (traffic noise) [4].

A main phenomenon as a consequence of repeated episodes of respiratory disruptions is the presence of so-called intermittent hypoxia, that stimulates the mechanisms of inflammatory response and accelerates atherosclerosis and carcinogenesis [5–7]. It is important to stress that because of disrupted airflow with a constant inspiratory effort the intrathoracic pressure increases, baroreflex function decreases, causing bradycardia with the risk of cardiac arest [8]. Followed by hypoxia-induced sympathetic activity, which leads to tachycardia with arousal and arterial hypertension peak, these events repeat themselves during sleeping for over a hundred times [8]. Hence, sleep fragmentation, intermittent hypoxia, systemic inflammation and chronic sympathetic stimulation caused by OSA induce cardiovascular disorders, including the most common systemic hypertension, ischemic heart disease, congestive heart failure and heart arrhythmias [9, 10]. The occurrence or aggravation of metabolic dysbalance is also possible, specially the deterioration of carbohydrates and lipids metabolism, with the development of a metabolic syndrome Z [1, 2, 11–14]. OSA exacerbates clinical course of respiratory disorders, chronic obstructive pulmonary disease (COPD) asthma and deepens respiratory insufficiency [15]. Gastrointestinal disorders, gastroesophageal reflux disease and hepatic dysfunction are also present [16]. Neurological deficits, cerebrovascular diseases and nerve damage, caused by hypoxia and accelerated atherosclerosis are a repercussion of OSA, as well [17]. Mental health conditions, among which depression mostly, are the complication of OSA [1, 2, 18].

OSA is caused by abnormal anatomy and physiology of the upper airway [19, 20]. That includes obesity, hypothyroidism, tongue and pharyngeal muscle hypotonia, enlarged tonsils, nasal obstruction, prolonged soft palate, enlarged uvula, mandibular retrognathia and micrognathia, macroglossia, narrow maxilla, gothic palate and other [1, 2, 11–13, 21, 22].

OSA therapy

The diagnosis of sleep-disordered breathing is made by polysomnography testing in specialized centers. Depending on the type and severity of the disorder (mild - AHI 5-15, moderate - AHI 15-30, severe - AHI >30), different therapeutic modalities are available, which can roughly be divided

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into conservative and surgical therapy [23]. More practically four groups of treatment are distinguished [19]: hygienic-dietary regimen and lifestyle; surgical approach to upper airways; use of oral appliances (OA) and noninvasive ventilation with continuous positive airway pressure (CPAP). CPAP is a gold standard in sleep apnea syndrome treatment, especially in severe forms of OSA. Depending on the severity of OSA different types of CPAP machines are used [1, 2]. Its efficacy is practically provided in the elimination of apneas and daytime sleepiness, which Sullivan et al. [24] proved back in 1981. Nevertheless, not infrequently patients barely tolerate and accept this device [23]. Only one year after Sullivan et al. [24], Cartwright and Samelson [25] introduced, as a therapy option, tongue-retaining device, the first oral appliance in use.

Oral appliances in the OSA – the Dentist's Role

The name "oral appliance" varies. There are synonyms for both terms: dental, intraoral or mandibular can be used instead of oral, and instead of appliance there are devices, splint or prosthesis [26]. In general terms, this treatment approach relies on repositioning of the mandible and/or tongue and related soft tissues in such a way that the upper airway calib [27]. The potential advantages of such an approach, particularly relative to the current gold standard CPAP, include its simplicity, portability, lack of noise and independence from a power source, and potentially lower cost [19]. Aside from therapeutic effect, one of the advantages is sleep and rest quality improvement of the bed partner, thus promoting partner's health and relationship [26]. All of this has a positive impact on patient acceptance.

Types of oral appliances

Oral appliances used for OSA generally fall into one of two classes: mandibular advancement splints (MAS) (Figure 1), and tongue retaining devices (TRD).

MAS induce protrusion of the mandible by anchoring a removable device to part of or the entire upper and lower dental arches, while TRD uses a negative pressure of a suction cavity to protrude the tongue out of the mouth. MAS are far more widely used in clinical practice and there is the extensive literature on their use, compared to TRD. There are many designs available, but they generally fall into either one-piece (monobloc) or two-piece (duobloc) configurations. Beyond this, they can differ substantially in size, type of material, coupling mechanism, amount of occlusal coverage, degree of customization to the patient's dentition, titratability of mandibular advancement, degree of mandibular mobility permitted, and allowance for oral respiration. Although prefabricated appliances are commercially available, it has been proven that the best clinical outcome is achieved with custom-made oral appliances [23, 26]. Using intraoral devices increases the volume of upper airways, primarily on the account of lateral and partly anteroposterior dimensions, along with decreased pharyngeal wall collapsibility [28], which has been proven clinically by computerized tomography (CT) [29, 30], magnetic resonance imaging (MRI) [31, 32] and video endoscopy [33]. Most of the radiological studies were performed on patients while awake, therefore it is unknown if the same alterations occur during sleep [26].

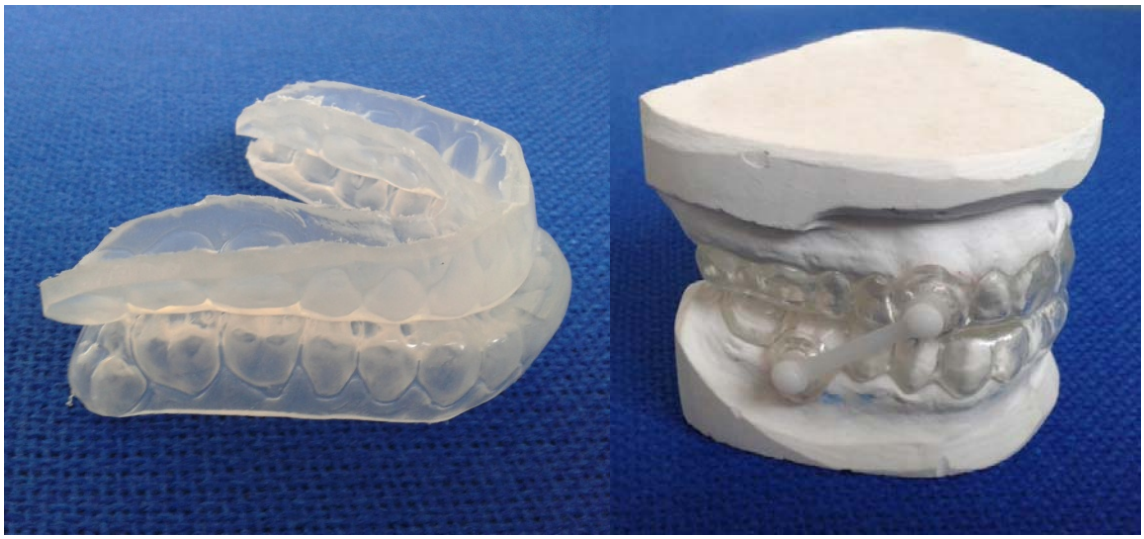

Fig. 1 – Mandibular advancement splints.

Indications

Major indications for this appliance are mild-to-moderate OSA-hypopnea syndrome, in case a patient does not tolerate, is unwilling to accept or unable to comply with CPAP therapy; as well as severe OSA-hypopnea syndrome, in case of CPAP therapy failure [23, 26].

Clinical trials and findings

The effect of OAs on polysomnographic outcomes has been extensively evaluated, and there is strong evidence of clinical benefit in controlling or significantly reducing the

number of obstructive breathing events and arousals, and improving arterial oxygen saturation, particularly in the mild-to-moderate OSA range [19, 23, 34]. It has been confirmed that intraoral devices decrease daytime sleepiness, as well as neurocognitive functioning [35, 36]. The overall success rate is dependent on the definition used, with almost 70% of patients achieving a greater than 50% reduction in AHI [36], and up to 50% achieving an AHI < 5/hour [30, 31, 37, 38]. Previous studies have demonstrated that oral appliances use results in the reduction of blood pressure [36–38]. Beneficial impact was found also in other cardiovascular diseases, in cardiac and endothelial function, as well as in oxidative stress markers, which needs to be investigated in further studies [26, 36–43]. Concerning snoring, intraoral appliances decrease snoring frequency in 40–60%, and intensity to 3 dB [44, 45]. Similarly, MAS has a good therapeutic effect on bruxism coupled with OSA [26].

Clinical predictors of efficacy and tolerance of OA are not well designed so far [26, 34]. From one side, persistent snoring while using the MAS could be a sign of inefficiency in preventing apneas [46]. From the other, milder sleep apnea syndrome, supine position dependent apnea, female sex and lower obesity grade have positive influence on the treatment outcome [24].

Period of adjustment

It is important to note that the patient requires a period of adjustment between two weeks and a month before oral therapy appliances demonstrate their effectiveness. The biggest factor is to adjust the patient's response to the new position of the mandible, which the OA causes during sleep [44, 47, 48]. A period of up to six months of everyday use of MAS with progressive adjustment of mandibular protrusion degree is necessary for the patient's adjustment and satisfactory response [26].

Side-effects

All oral appliances, regardless of design, have potential short- and long-term side effects. Most patients experience acute adverse effects during the initial phase of treatment. Excessive salivation (38–50%) and transient dental discomfort (33%), particularly of the upper and lower front teeth, for a brief time after awakening, are commonly reported with initial use and may preclude early acceptance of an oral appliance [36]. Temporomandibular joint discomfort (12.5–33%), dryness of the mouth (28–46%), gum irritation (20%), headaches and bruxism (12.5%) are other side effects that have been reported [44, 46, 49]. Although these acute side effects are common, for most patients these are minor and transient, subsiding with continued use of the OA. Potential long-term adverse effects can be broken and/or loosened teeth, dislodgement of existing dental restorations, tooth mobility, periodontal complications, muscle spasms, and otalgia [50–54]. These complications can often be avoided by simple recognition and appropriate early response to initial complaints. To monitor for these potential problems, it is suggested that patients with OAs should make periodic visits to the treating dental clinician.

Contraindications

According to numerous clinical trials, OAs are not recommended in case of severe periodontopathy [26]. The Food and Drug Administration of USA does not recommend OAs in case of coexisting central sleep apnea, severe respiratory disease, loose teeth and periodontopathy, as well as for the population younger than 18 years because of insufficient evidence [55]. Despite lateral mouth openings, they are contraindicated in severe nasal obstruction [33, 56]. In case of limited mandibular protrusion, enlarged tongue, edentulousness and edentulism the tongue-retaining device has advantage, while mandibular protrusion splint requires eight stable teeth in each jaw [26]. Pain in temporomandibular joint is not a contraindication. Use of OAs in bruxism (crunching of teeth) during sleep is not contraindicated, but recommended as a mode of therapy.

It could be said that, there has been a significant improvement in the quantity and quality of research and the use of intraoral appliances [45, 57] in the previous decade. Despite great progress, it is still a challenge to make a final and definitive recommendation on the use of intraoral appliances for various types that are used, as well as different types of patients and their anatomical configuration [23].

Conclusion

The cooperation between sleep medicine laboratories and dentists is essential for appropriate selection of patients that can benefit from MAS treatment for OSA.

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