

# APPLICATION OF PROSTHETIC DEVICES IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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## Abstract

**Introduction.** The most common form of sleep disorders is obstructive sleep apnea (OSA), which is characterized by repetitive, complete or partial closure of the upper respiratory tract during sleep, leading to its fragmentation and oxygen desaturation. This disorder is related to the impairment of daytime functioning, what significantly affects the quality of life, the risk of cardiovascular diseases, strokes and metabolic disorders. There are different ways of OSA therapy. One of the possibilities is the use of oral devices.

**Aim.** The aim of the work is to discuss the importance of early treatment of obstructive sleep apnea for health and the presentation of the possibility of using prosthetic devices in patients suffering from OSA.

**Materials and methods.** Based on articles devoted to the subject of obstructive sleep apnea therapy with the use of prosthetic devices, 37 items were finally selected. The scientific bases were used for searching: PubMed, Dentistry & Oral Sciences Source, Elsevier, Web of Science, Scopus. Keywords used in the search process were the following: obstructive sleep apnea, mandibular advancement, oral devices, prosthodontic appliance.

**Results.** Prosthodontic devices are indicated for use in patients with mild to moderate forms of this disorder. They can be used in patients who do not tolerate treatment with CPAP in primary snoring. There is a growing interest in using oral devices for the treatment of snoring and OSA. The rationale is that the correct position of the mandible and tongue has a positive effect on the function of the upper respiratory tract by enlarging them in the front and lateral direction.

**Conclusions.** The use of oral devices in the treatment of obstructive sleep apnea requires the proper construction of the device depending on the occlusal conditions and permanent control of the stomatognathic system by the dentist during the therapy.

**Keywords:** obstructive sleep apnea, mandibular advancement, oral/prosthodontic appliances, loss of teeth.

## Introduction

Breathing disorders during sleep are still a significant medical problem to which attention should be paid. It was not until the second half of the 20th century that breathing disorders began to be treated as separate disease classification. From year

to year, more and more patients with dysfunctions of the respiratory organ are diagnosed. It is associated with greater awareness of patients, better prophylaxis and high accuracy of diagnostic tests. Breathing disorders during sleep are common throughout the world, in different age groups, and affect both sexes. Untreated, they can lead to serious diseases of the nervous system and cardiovascular system over the years, and in the most severe cases, to death [1-4]. The occurrence of obstructive diseases has a diverse etiology, and the most common disorder of this group is obstructive sleep apnea (OSA).

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### **Obstructive sleep apnea and health**

Sleep is necessary for the proper functioning of the body. Along with the ongoing progress of civilization, an increasing part of the population suffers from its disorders. The correct sleep is organized into phases and stages that together form cycles. Maintaining the correct order, in particular deep sleep and REM sleep, is necessary to maintain homeostasis. Sleep disorders are a global problem with a prevalence in the population ranging from 4.4% to 48%. Such a discrepancy may result from differences in the definitions of insomnia that appear in the literature [5]. The frequency of incidence of ailments related to insomnia reaches 50.5% of the adult population in Poland [6,7].

During sleep, the muscle tone is physiologically reduced, including those muscles that dilate the throat, what leads to a complete or partial closure of the airway. Abnormalities in the structure of the jaw, an oblique position of the mandible or a lowered position of the hyoid bone and the occurrence of the flaccidity of the upper respiratory tract walls are conducive to this phenomenon. Decrease in the vertical dimension of the bite, change in the position of the mandible and change in the position of the hyoid bone, dysfunction of the oropharyngeal muscles, and enlargement of the tongue are a consequence of the loss of teeth and significantly impede the proper breathing process [4,8,9].

Most people think that snoring is just an unpleasant characteristic acoustic effect that accompanies breathing during sleep. In reality, snoring can be a symptom of a disorder that over the years can turn into obstructive sleep apnea. The sound effect

during sleep arises as a result of a decrease in muscle tone leading to the narrowing of the upper respiratory tract, which speeds up the air circulation. The uvula and the soft palate are set in vibrations, what results in snoring [10-12]. In people with obstructive sleep apnea, which accounts for 90% of all breathing disorders, snoring may appear in the first phase of sleep, immediately after falling asleep (REM phase). However, it is interrupted by moments of silence caused by apnea [13].

Obstructive sleep apnea is a disease characterized by repeated episodes of breathing limitation or stopping while the respiratory muscles work in an increased form [14]. OSA is a disease that develops progressively. Its beginning is often noticed by the family, as well as by people suffering from it [8,15]. There are two measures to assess obstructive sleep apnea, which include clinical symptoms and a laboratory index of apnea and hypopnea (AHI, *apnea-hypopnea indices*). OSA is diagnosed if at least five episodes of hypopneas or apneas per hour occur during sleep, and the degree of advancement is associated with an increase in the number of these episodes.

OSA is associated with sleep fragmentation, excitement, decrease in the amount of oxygenated blood and respiratory arrest, and sometimes also cardiac arrhythmias and acute cardiovascular episodes. Another factor that can be a complication of OSA is hypertension. As a result of apnea, there is a remodeling of the muscle layer in the walls of the vessels. The frequency and severity of hypertension depend on the form of OSA, but it has been shown that benign form doubles the chance of this disease. The studies have shown that ischemic heart disease often accompanies obstructive sleep apnea, which occurs 2-4 times more often in these patients and significantly increases the mortality rate. Increased demand for oxygen, changes in blood pressure, increased blood clotting can affect the occurrence of episodes of myocardial ischemia by affecting the atherosclerotic plaque. Recently, it has been shown that the correlation between OSA and inflammatory markers affects their growth, and this, in turn, causes the development of atherosclerosis. In addition, patients with OSA are at increased risk of diabetes, heart arrhythmias and reduced blood activity. Metabolic syndrome and diabetes are directly related to obesity. Excessive sleepiness in people suffering from OSA contributes to the occurrence of traffic accidents. In Poland, it was the cause of 8.6% of accidents, with 106 fatal victims and in the USA the number of accidents caused by this disease is estimated at 42-54% [8,14,16-22].

The management of this disease varies from patient to patient, as it depends on many factors and the severity of the symptoms. However, proper prevention, which is the same in all patients with obstructive sleep apnea, is the most important. It is recommended to sleep in the right position and avoid sleeping on the supine, avoiding drugs, alcohol, sedatives, and in the case of obesity – weight reduction [9].

## **Treatment of OSA**

Surgical and preventive methods are used in the treatment of OSA. The second group uses CPAP (Continuous Positive Airway Pressure), autoCPAP, BiPAP (Biphasic Positive Airway Pressure) apparatus and prosthetic devices that enlarge the throat space and regulate the degree of mandibular advancement. They will allow

the mandible to be extended to 75% of its maximum extension [3,15,23]. Intraoral devices are recommended to be used in mild cases, such as primary snoring and mild OSA, or as secondary treatment when using CPAP or alternative treatment in case of failure by CPAP treatment [24]. Apparatus used in preventive treatment can be divided into two groups: mandibular advancement devices (MAD), and devices for holding the tongue [25]. MAD provide high efficacy and significant efficiency compared to tongue retaining devices [26]. MAD devices are anchored on the patient's own teeth, therefore their effectiveness is directly related to retentions on dental arches [27]. Contraindications to treatment with this device include oral cavities with less than 10 teeth in the arch, due to insufficient apparatus retention. In the case of patients with larger missing teeth, the combination of the device and the partial denture may be used [28,29]. Meyer and Knudson [30] were first to design a device in the form of an acrylic monoblock that prevented sleep apnea in a toothless patient. Some authors recommend using full dentures during sleep in patients with OSA. They accept such a solution because of the positive impact on the process of free breathing by changing the position of the tongue, mandible and patency of the upper respiratory tract and lowering the AHI index. The use of such a solution should be cautious, due to the possibility of inflammation of the oral mucosa [31-34]. Giannasi *et al.* [35] introduced the use of the PM positioner, combined with the full jaw prosthesis and allowing the mandibular position to be changed. Kurtulmus and Cotert [36] introduced a functional, acrylic monoblock rail, combining the function of the rail that moves the mandible and retains the tongue. Piskin *et al.* [37] described the method of preparation and efficacy of acrylic treatment, a monoblock modified mandibular advancement device (MAD) that works by moving large masseter muscles to the side to provide more space for the tongue for a completely edentate patient with severe OSA. Two-piece mandible repositioning appliances (MRAs) based on intraosseous implants are also used. Studies indicate that oral therapy is effective in controlling OSA in up to 50% of patients, including some patients with severe forms of OSA, they are not widely used [38].

## Conclusions

The growing interest in the problem of sleep disorders and the negative impact on health prompts to look for different solutions to this problem. The prospect of using prosthetic devices significantly expands the possibilities of treating patients with OSA mostly in mild forms.

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