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Obstructive Sleep Apnea-Hypopnea Syndrome (OSAHS): Review of the Literature

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ABSTRACT

Obstructive sleep apnea-hypopnea syndrome (OSAHS) is a common chronic sleep disorder. As the incidence of OSAHS increases, it has seriously threatened people's health. It causes significant morbidity and mortality in both developed and developing countries around the world. However, clinical trials of OSAHS have heterogeneous outcomes, surrogate outcomes, subjective outcomes, composite outcomes, and a lack of endpoints or patient perspectives. The diagnosis is confirmed by a sleep study. The main treatment for OSAS is the use of continuous positive airway pressure (CPAP) at night via a nasal or oronasal mask, which usually results in rapid improvement of symptoms. Patients who cannot tolerate CPAP therapy can be successfully treated with a mandibular advancement device. Supportive measures include regular and sufficiently long sleep periods, refraining from smoking and alcohol consumption in the evening, and weight reduction in overweight patients.

Keywords: Obstructive sleep apnea-hypopnea syndrome, continuous positive airway pressure, apnea-hypopnea index

INTRODUCTION

Obstructive sleep apnea-hypopnea syndrome (OSAHS) is a common, chronic sleep disorder in which respiratory arrest and hypoventilation frequently occur during sleep[1]. This syndrome is associated with a characteristic clinical presentation and specific abnormalities on examination. In OSAHS, there is repetitive upper airway collapse, which may be partial or complete, resulting in hypopnea or apnea; during sleep, this occurs more than five times per hour (apnea-hypopnea index (AHI) [2]. There is also clinical evidence that OSAHS may contribute to the development of hypertension, cardiovascular disease, and abnormalities in glucose metabolism [3, 4]. Apnea refers to a pause in breathing of more than 10 seconds and occurs in both central sleep apnea (CSA) and obstructive sleep apnea (OSA). They are distinguished by a lack of respiratory effort in CSA as opposed to a sustained but ineffective respiratory effort in OSA. Hypopnea is defined as a reduction in ventilation of at least 50%, resulting in a reduction in arterial saturation of 4% or more due to partial airway obstruction [5]. Early detection and appropriate therapy are the main options to treat the disease [6]. Overnight polysomnogram is the standard test for diagnosing OSAHS [7]. It can simultaneously record several physiological signals during sleep, such as electroencephalogram, electrooculogram,

electromyogram, oronasal airflow, and oxyhemoglobin saturation. Because OSAHS is a chronic disease, treatment is mainly aimed at relieving upper airway obstruction. Patients must be continuously educated and followed up to adjust the treatment strategy in a timely manner to ensure efficacy [8]. Lifestyle modifications such as weight loss, abstaining from alcohol and sedatives, smoking cessation, and avoiding sleep deprivation can reduce both the symptoms of OSAHS and concomitant diseases [9].

The best way to improve outcome reporting is to develop a core outcomes set (COS), which is the minimum set of outcomes for which all studies in a given setting are scientifically consistent and reported [10]. The COS must be measurable and relevant. Involvement of patients and other key stakeholders is key to achieving relevance. Studies have shown that the COS can make reporting of trial results more standardized [11]. This review briefly describes clinicians who assess patients with OSAHS. It discusses the definition, pathophysiology, clinical presentation, complications, polysomnographic findings, and treatment of OSAHS. As the effects of OSAHS are better understood, clinicians are more aware of this syndrome, and the demand for sleep medicine services has increased.

Over the past decade, the number of sleep centers accredited by the American Academy of Sleep Medicine (AASM) and the number of sleep medicine physicians accredited by the American Board of Sleep Medicine have increased by approximately 300%. Despite this growth in sleep medicine, waiting lists at sleep disorder centers are long, and the vast majority of patients remain undiagnosed. The increasing prevalence of obesity [3] and a better understanding of the relationship between OSAHS and cardiovascular disease will significantly impact the healthcare system.

Epidemiology

OSAS is the second most common condition in terms of frequency among the various respiratory diseases, surpassed only by asthma. The syndrome can affect any age group and is estimated to affect 2-4% of the adult population, with a higher incidence in middle-aged men. One in five adults suffers from moderate OSAS and one in 15 from moderate to severe OSAS [12]. The syndrome is characterized by tense breathing, decreased blood oxygen levels, and agitation that disrupts normal sleep. In some cases, there is a high health risk, and patients may suffer from excessive daytime sleepiness, early morning headaches, difficulty concentrating, social problems, and systemic disorders [13].

Prevalence estimates for OSAS vary from study to study depending on research design and sampling criteria. The American Academy of Sleep Medicine (AASM) defines OSAS as AHI C 5 plus the presence of two or more symptoms, such as daytime sleepiness or snoring [14]. Many researchers hypothesize that a large proportion of the general population suffers from increased AHI but has no associated symptoms [15]. For example, in a representative sample of US men, the prevalence of OSAS (defined by AHI 10 and the presence of symptoms during the day) was 3.3%, whereas the prevalence of AHI [5] was 17%, suggesting that many people suffer from respiratory symptoms but may not experience or report symptoms of OSAS. Similarly, 9% of women and 24% of men were found to have a AHI of C 5 but had no symptoms of OSAS. Thus, current prevalence estimates for OSAS do not capture all people who have sleep-disordered breathing. In a representative sample, one in four adults in the United States was found to be at high risk for OSAS [16].

Pathophysiology

Apnea and hypopnea are caused by the airway being swallowed when breathing in during sleep. This occurs because the muscles used to dilate the upper airway, which are also striated muscles, normally relax during sleep. In patients with OSAHS, the dilator muscles can no longer

successfully counteract the negative pressure in the airway during inspiration [5]. Patients have narrow upper airways. The airways are kept open by the dilator muscles, which have a higher activity than normal during wakefulness. But during sleep, muscle tone decreases and the airway narrows [5]. Snoring may then occur, followed by airway obstruction and subsequent apnea. Features of this condition include hypoxemia, hypercapnia, large intrathoracic pressure fluctuations (up to 120 mm Hg), and an increase in systemic blood pressure of up to 250/150 mm Hg associated with arousals occurring up to 100 times per hour and sleep fragmentation [2]. Symptoms include excessive daytime sleepiness, nonrestorative sleep, nocturia, loud snoring, apnea and retching during sleep, morning headache, and sexual dysfunction.

Predisposing factors include any factor that causes narrowing of the pharynx, such as obesity (more than 50% of obese patients have a body mass index (BMI) greater than 30 kg/m2) and shortening of the mandible or maxilla. Changes in jaw shape can be mild and familial. Hypothyroidism and acromegaly predispose to OSAHS by narrowing the upper airway through tissue infiltration. Male gender, middle age (40-65 years), myotonic dystrophy, Ehlers-Danlos syndrome, and possibly smoking are also risk factors [5]. The syndrome also occurs in childhood and is usually associated with tonsillar or adenoid enlargement.

CONSEQUENCES OF OSAHS

Neurobehavioral and Social

Excessive daytime sleepiness, impaired vigilance, mood disturbances, and cognitive impairment are the hallmarks of OSAHS. The pathophysiological mechanisms involved in the effects of OSA on the brain remain poorly characterized but are likely complex and multifactorial. Proposed mechanisms, described below, include intermittent hypoxemia, sleep fragmentation and alterations in sleep architecture, hemodynamic and vascular alterations, disruption of the blood-brain barrier, abnormal waste disposal, and changes in synaptic plasticity leading to structural and functional brain changes (Figure 1) [17]. Somnolence can lead to inability to work efficiently, and it can interfere with interpersonal relationships and prevent social contact. Somnolence is dangerous when driving, leading to a three- to six-fold increase in traffic accidents or operating machinery [17]. The partners of patients with OSAHS suffer from poor sleep, and it is often the partner who initiates the investigation because they are seeking relief from loud snoring and disruptive apneas.

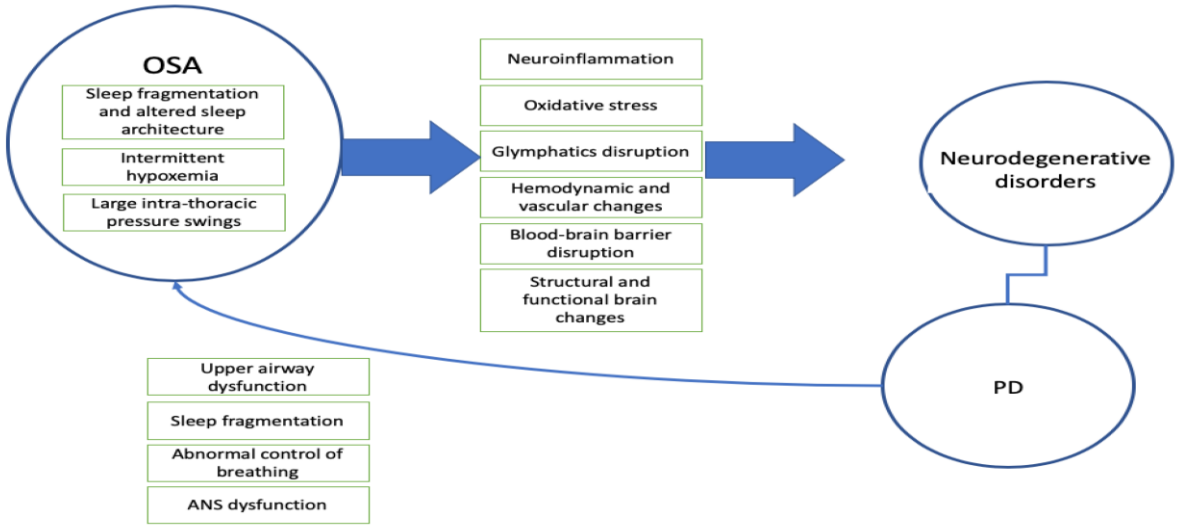

Figure 1. The relationship between obstructive sleep apnea and neurodegenerative disorder

Cardiovascular

For years, a relationship between OSAHS and hypertension has been suspected based on clinical observations and biological plausibility. Intermittent hypoxia, negative intrathoracic pressure fluctuations, and arousals characteristic of apneas and hypopneas result in an acute increase in blood pressure at cessation of respiratory failure that develops into sustained hypertension via chronically increased sympathetic nervous system activity and arterial baroreceptor dysfunction [17]. The strongest demonstrated association comes from the Wisconsin Sleep Cohort Study, an ongoing study of state employees undergoing serial laboratory polysomnography, which has shown a dose-dependent association between apnea-hypopnea frequency at baseline and the development of hypertension at follow-up. With an apnea-hypopnea frequency of 15/h at baseline, the odds ratio for hypertension at 4 years was 2.89 (95% confidence interval, 1.46-5.64) compared with zero events per hour, after adjustment for known confounding variables. Hypertension associated with OSAHS may be more difficult to treat. Sleep apnea is listed first in the table of identifiable causes of hypertension in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure [18]. Data on the effect of OSAHS treatment on blood pressure are inconsistent; some intervention studies show a beneficial effect.

Large population-based studies have associated OSAHS with cardiovascular and cerebrovascular disease, and retrospective data suggest that untreated OSAHS is associated with increased mortality. The Sleep Heart Health Study has demonstrated cross-sectional dose-dependent associations between OSAHS and vascular disease. More than 6000 subjects from multiple longitudinal cardiovascular cohorts were studied with in-home polysomnography. The multivariate adjusted probability of self-reported cardiovascular disease was 1.42 (95% confidence interval, 1.13-1.78) for those in the highest quartile of apnea-hypopnea frequency (11/h), with the strongest association with heart failure and stroke [10]. Although a skeptical person might conclude that the association of OSAHS with cardiovascular disease is modest, it is within a range of apnea-hypopnea frequencies (5-15 events per hour) that occurs in 1 in 15 adults [5]. Prospective data on whether OSAHS treatment improves cardiovascular morbidity or mortality are limited. However, a recent study found that optimal heart failure treatment was achieved only when OSAHS was eliminated [19].

Perioperative and Postoperative

Patients with OSAHS may have increased perioperative risk, but data quantifying the risk are limited. Endotracheal intubation may be more difficult in these patients, and forced supine positioning and analgesics may result in upper airway narrowing postoperatively. A retrospective study of 101 patients who underwent hip or knee arthroplasty and had or were later found to have OSAHS compared with 101 age-, sex-, and surgery-matched control groups found that the percentage of patients with complications was higher (39% in the OSAHS group versus 18% in the control group) and the hospital stay was longer in the OSAHS group (6.8±2.8 versus 5.1±4.1 days) [20]. Only 12 of 33 patients who used continuous positive airway pressure (CPAP) therapy at home preoperatively were prescribed CPAP therapy in the hospital postoperatively and before the onset of complications, and only 3 patients had CPAP therapy scheduled in the recovery area after anesthesia.

RECOGNITION OF OSAHS

History and Physical Examination

The history focuses on breathing disturbances during sleep, unsatisfactory sleep quality, daytime dysfunction, and OSAHS risk factors. A secondary history should be obtained from the patient's bed

partner. Reports of habitual, socially disruptive snoring and witnessed apneas terminated by snorting or gasping increase diagnostic accuracy. Sleepiness lacks diagnostic sensitivity and specificity. The onset of sleepiness may be so insidious that the patient is unaware of its development, and the symptom is more often due to chronic inadequate sleep duration in the general population. Obstructive sleep apnea-hypopnea syndrome is 2 to 3 times more common in men [21]. This sex protective effect is diminished in premenopausal overweight women (body mass index [BMI] ≥32 kg/m2), menopausal women not receiving hormone replacement therapy, and overweight women receiving hormone replacement therapy [21]. Prevalence appears to stagnate after age 65[22]. Other risk factors may include smoking, alcohol, and nasal congestion.

An adequate physical examination is also required (height, weight, body mass index, and cardiovascular assessment), including examination of the upper airways (nasal passages, oropharynx, hypopharynx, and larynx). The above data should in turn be supplemented by a radiological examination in the form of a conventional lateral radiograph or a three-dimensional radiograph [23], which reveals the craniofacial anatomical changes that predispose to OSAS [24].

Numerous tests are available for sleep assessment and diagnosis of OSAS. The most widely used technique is polysomnography (PSG) [25], which monitors sleep status, respiration, electrocardiogram, leg movements, oximetry, and snoring. In addition, PSG records the distribution of sleep stages, the number of awakenings, the number of apneas or hypopneas, the onset 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 if AHI > 30, while AHI 15-30 defines moderate apnea and a AHI value of < 15 indicates mild apnea. PGS provides a lot of information but is a complex and expensive technique, which limits its practicality in the evaluation and treatment of OSAS. For this reason, simple tests have been developed and are now used in many health care settings. These techniques provide less information but are cheaper and can be used in patients' homes [26].

Pulse Oximetry

Obstructive apneas and hypopneas result in repetitive "sawtooth" fluctuations in oxyhemoglobin saturation in a temporally compressed profile. Published sensitivities and sensibilities vary widely due to non-standardized oximetry data collection and study populations. Pulse oximetry is not considered a sole sufficient alternative to polysomnography for the diagnosis of OSAHS. The utility of pulse oximetry may lie at the extremes of the OSAHS spectrum [2]. When clinical suspicion of OSAHS is high, pulse oximetry may help determine when to schedule polysomnography if admission to a sleep center is delayed. When clinical suspicion is low, normal examination findings effectively rule out OSAHS. However, RERAs are not detectable by pulse oximetry because arousals occur before ventilation or oxyhemoglobin saturation is impaired. Therefore, sleepy patients with normal oximetry findings require further evaluation.

Other Diagnostic Test Strategies

Numerous efforts have been made to modify standard polysomnography because it is cumbersome for patients, labour intensive, and difficult to access in many laboratories. One strategy that has proven successful is two-night polysomnography - the initial diagnostic portion is followed by CPAP titration on the same night [20]. There are a number of more limited diagnostic monitoring systems, some of which are designed for unattended home use. The role of these systems remains uncertain. For CPAP to be reimbursed, the diagnosis of OSAHS must be made by a

polysomnogram in a facility (not home or mobile) and AHI must be based on at least 120 minutes of sleep. Nonetheless, technological advances and access pressures suggest further efforts to align the scope of diagnostic testing with the pretest probability of OSAHS.

TREATMENT OF OSAHS

Obstructive sleep apnea-hypopnea syndrome is a chronic condition that requires patient education, relief of upper airway obstruction, and ongoing follow-up with adjustment of treatment strategies to ensure efficacy. Because many patients with OSAHS are overweight or have comorbid cardiovascular risk factors or disease, they need to be informed about the interaction between OSAHS and overall health. Prospective data on the cardiovascular and perioperative benefits of OSAHS treatment are emerging, but hypersomnolence is currently the most widely accepted treatment goal for patients and clinicians [27]. The American Association of Sleep Disorders [28] has proposed the use of oral devices to eliminate snoring or sleep apnea and has classified them as follows: Mandibular advancement appliances, lingual retainers, soft palate appliances, and combined advancement and positive pressure appliances. Mandibular advancement appliances are usually made with an advancement of 80% of the maximum protrusion [29]. There are monobloc types and appliances made with two splints; no differences in success rates between the two designs have been noted [30]. The success of these appliances is associated with lower AHI scores obtained by PSG [31]. Regarding the side effects of these appliances, several authors have reported pain in the maxillary and mandibular incisors, joint discomfort, dental or facial muscle discomfort, excessive salivation, dry mouth, headache, and bruxism [26, 32].

Continuous Positive Airway Pressure

The decision to treat OSAHS usually involves trial use of CPAP, a device that pneumatically splints the upper airway during inspiration and expiration. A placebo-controlled randomized trial [33] showed that CPAP reduced sleepiness and increased quality of life. During polysomnography, CPAP is titrated to a level that eliminates snoring, RERAs, and apneic hypopneas, and is then usually prescribed at a "fixed" level, typically the pressure necessary to maintain airway patency under conditions of greatest vulnerability (REM supine sleep). For most patients, the prescribed pressure is in the range of 7 to 11 cm H2O. CPAP systems consist of a blower connected to a nasal inlet via a 180-cm flexible tube. They weigh approximately 2.2 kg and can be transported in a soft case. CMS criteria for CPAP reimbursement are a AHI of 15 or more or a AHI of 5 to 14 with documented symptoms of excessive sleepiness, impaired cognition, mood disorders or insomnia, or documented hypertension or ischemic heart disease or a history of stroke.

CONCLUSION

Even mild OSAHS may be associated with marked behavioral, social, and cardiovascular morbidity. It is therefore not surprising that patients with untreated OSAHS have higher health care utilization and medical costs[33]. More data are needed to define the specific cardiovascular risks of untreated OSAHS and to determine the extent of the impact of treatment. OSAHS should be suspected in patients with habitually loud snoring, witnessed apneas, gagging or wheezing during sleep, hypertension, neck circumference of 43 cm or more, obesity, and a laterally narrowed oropharynx.

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REFERENCES

1. Park, J.G., K. Ramar, and E.J. Olson. *Updates on definition, consequences, and management of obstructive sleep apnea*. in *Mayo Clinic Proceedings*. 2011. Elsevier.
2. Crummy, F., A. Piper, and M.T. Naughton, *Obesity and the lung: 2· Obesity and sleep-disordered breathing.* Thorax, 2008. 63(8): p. 738-746.
3. Peppard, P.E., et al., *Prospective study of the association between sleep-disordered breathing and hypertension.* New England Journal of Medicine, 2000. 342(19): p. 1378-1384.
4. Peker, Y., J. Carlson, and J. Hedner, *Increased incidence of coronary artery disease in sleep apnoea: a long-term follow-up.* European Respiratory Journal, 2006. 28(3): p. 596-602.
5. Desalu, O., et al., *Prevalence, awareness and reporting of symptoms of obstructive sleep apnoea among hospitalized adult patients in Nigeria: a multicenter study.* Ethiopian Journal of Health Sciences, 2016. 26(4): p. 321-330.
6. Marin, J.M., et al., *Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study.* The Lancet, 2005. 365(9464): p. 1046-1053.
7. Punjabi, N.M., *The epidemiology of adult obstructive sleep apnea.* Proceedings of the American Thoracic Society, 2008. 5(2): p. 136-143.
8. Barnes, M., et al., *A randomized controlled trial of continuous positive airway pressure in mild obstructive sleep apnea.* American journal of respiratory and critical care medicine, 2002. 165(6): p. 773-780.
9. Johansson, K., et al., *Effect of a very low energy diet on moderate and severe obstructive sleep apnoea in obese men: a randomised controlled trial.* Bmj, 2009. 339.
10. Young, A., et al., *Agreement on what to measure in randomised controlled trials in burn care: study protocol for the development of a core outcome set.* BMJ open, 2017. 7(6): p. e017267.
11. Kirkham, J.J., et al., *Outcome measures in rheumatoid arthritis randomised trials over the last 50 years.* Trials, 2013. 14(1): p. 1-8.
12. Young, T., et al., *Population-based study of sleep-disordered breathing as a risk factor for hypertension.* Archives of internal medicine, 1997. 157(15): p. 1746-1752.
13. Laube, I., et al., *Accidents related to sleepiness: review of medical causes and prevention with special reference to Switzerland.* Schweizerische Medizinische Wochenschrift, 1998. 128(40): p. 1487-1499.
14. Force, A.A.o.S.M.T., *Sleep-related breathing disorders in adults: recommendations for syndrome definition and measurement techniques in clinical research.* Sleep, 1999. 22: p. 667-689.
15. Young, T., et al., *Sleep disordered breathing and mortality: eighteen-year follow-up of the Wisconsin sleep cohort.* Sleep, 2008. 31(8): p. 1071-1078.
16. Hiestand, D. and B. Phillips, *Obstructive sleep apnea syndrome: assessing and managing risk in the motor vehicle operator.* Current opinion in pulmonary medicine, 2011. 17(6): p. 412-418.
17. Gosselin, N., et al., *Obstructive sleep apnea and the risk of cognitive decline in older adults.* American journal of respiratory and critical care medicine, 2019. 199(2): p. 142-148.
18. Kaneko, Y., et al., *Cardiovascular effects of continuous positive airway pressure in patients with heart failure and obstructive sleep apnea.* New England Journal of Medicine, 2003. 348(13): p. 1233-1241.
19. Gupta, R.M., et al. *Postoperative complications in patients with obstructive sleep apnea syndrome undergoing hip or knee replacement: a case-control study*. in *Mayo Clinic Proceedings*. 2001. Elsevier.
20. Bixler, E.O., et al., *Prevalence of sleep-disordered breathing in women: effects of gender.* American journal of respiratory and critical care medicine, 2001. 163(3): p. 608-613.
21. Young, T., et al., *Predictors of sleep-disordered breathing in community-dwelling adults: the Sleep Heart Health Study.* Archives of internal medicine, 2002. 162(8): p. 893-900.
22. Tso, H.H., et al., *Evaluation of the human airway using cone-beam computerized tomography.* Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 2009. 108(5): p. 768-776.
23. Goodday, R., *Diagnosis, treatment planning, and surgical correction of obstructive sleep apnea.* Journal of oral and

maxillofacial surgery, 2009. 67(10): p. 2183-2196.
24. Kushida, C.A., et al., *Practice parameters for the indications for polysomnography and related procedures: an update for 2005.* Sleep, 2005. 28(4): p. 499-523.
25. Flemons, W.W., et al., *Access to diagnosis and treatment of patients with suspected sleep apnea.* American journal of respiratory and critical care medicine, 2004. 169(6): p. 668-672.
26. Engleman, H.M., *When Does 'Mild'Obstructive Sleep Apnea/Hypopnea Syndrome Merit Continuous Positive Airway Pressure Treatment?* American journal of respiratory and critical care medicine, 2002. 165(6): p. 743-745.
27. Rodríguez Lozano, F.J., et al., *Sleep apnea and mandibular advancement device: revision of the literature*. 2008.
28. Shoaf, S.C., *Sleep disorders and oral appliances: what every orthodontist should know*. Journal of Clinical Orthodontics: JCO, 2006. 40(12): p. 719-722.
29. Randerath, W.J., et al., *An individually adjustable oral appliance vs continuous positive airway pressure in mild-to-moderate obstructive sleep apnea syndrome.* Chest, 2002. 122(2): p. 569-575.
30. Liu, Y., et al., *Cephalometric and physiologic predictors of the efficacy of an adjustable oral appliance for treating obstructive sleep apnea*. American Journal of Orthodontics and Dentofacial Orthopedics, 2001. 120(6): p. 639-647.
31. Hammond, R.J., et al., *A follow-up study of dental and skeletal changes associated with mandibular advancement splint use in obstructive sleep apnea*. American Journal of Orthodontics and Dentofacial Orthopedics, 2007. 132(6): p. 806-814.
32. Martínez-Gomis, J., et al., *Five years of sleep apnea treatment with a mandibular advancement device: side effects and technical complications.* The Angle Orthodontist, 2010. 80(1): p. 30-36.
33. *The relationship between chronically disrupted sleep and healthcare use*. Sleep, 2002. 25(3): p. 289-296.

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