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Review Article

Obstructive Sleep Apnea and Dentistry: A Detailed Review of Current Perspectives and Clinical Impact

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ABSTRACT

Major effects on oral and systemic health resulting from the challenging sleep-associated respiratory disorder known as obstructive sleep apnea (OSA) are related to: Research revealing similar anatomical and functional areas between dentistry and sleep medicine underscores the increasing relevance of the dental practitioner in OSA treatment. Combining insights from multiple patient backgrounds, this overview presents the current knowledge on the objectives of dentistry in the screening, diagnosis, and treatment of obstructive sleep apnea (OSA). Together with craniofacial risk factors and intraoral symptoms observed in dental examinations, the pathogenesis and typical clinical characteristics of OSA are discussed in the review. Oral appliance treatment is being closely examined in conjunction with continuous positive airway pressure (CPAP) therapy, with an emphasis on design modifications, clinical efficacy, and long-term outcomes. Utilizing maxillomandibular advancement and interceptive orthodontics, this research explores orthodontic and surgical treatment options. These methods demonstrate the extent to which structural dental alterations increase airway patency. The paper addresses current challenges to effective use, including constraints in the area of practice, patient adherence issues, and instructional gaps. Ultimately, it advances research on digital technologies, outcome monitoring, and interprofessional training projects. By orienting dental practitioners as cooperative participants in OSA treatment, this research highlights the importance of developing integrated clinical pathways and strengthening training frameworks to facilitate evidence-based practice in dental sleep medicine.

Keywords: Craniofacial Risk Factors, Interprofessional Collaboration, Obstructive Sleep Apnea, Oral Appliance Therapy

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|| INTRODUCTION

Obstructive Sleep Apnea (OSA) is a common and potentially serious sleep disorder characterized by low oxygen levels and irregular breathing patterns [1]. Among the primary consequences this issue generates on health are increased risk of cardiovascular illnesses, hypertension, stroke, diabetes, and worse cognitive capacity. OSA may occasionally be misdiagnosed since people may not seek medical attention until more serious health problems develop or their changed sleeping patterns are noticed [2]. Although most doctors, especially pulmonologists and sleep experts, are aware of and treat OSA, its relationship with dentistry has become increasingly significant in recent years. Many individuals display early symptoms of OSA; therefore, regular dental visits are most suitable for their detection [3]. Among these are dry mouth, teeth grinding (i.e., bruxism), and a higher risk of periodontal disease, in addition to daytime sleepiness. Usually, dentists first observe craniofacial and dental deformities, including malocclusion, a short or retrognathic jaw, or large tonsils, which may either result from OSA or contribute to its development. Dentists are thus significant members of the healthcare team involved in the management of OSA, as these components are essential for the prevention, early detection, and treatment of OSA [4].

The purpose of this review study is to find out what individuals think about the connection between obstructive sleep apnea and oral behavior right now. It talks about how dentists may aid with obstructive sleep apnea (OSA) and how they can help with therapy in a method that encompasses a lot of different areas. There will also be talk about dental appliances, continuous positive airway pressure (CPAP) therapy, and surgical therapies. There will also be talk about new ways to diagnose sleep apnea, like polysomnography and home sleep apnea tests. People are very interested in dental treatments since there is a lot of evidence that they work. Mandibular advance devices (MADs) are one of these treatments that can help with mild to severe obstructive sleep apnea (OSA). Many patients have seen a big improvement in their lives because to these oral devices. They are a less invasive way to treat CPAP, which helps with symptoms and makes life better [5].

Dentists should participate in the multidisciplinary therapy of OSA, as their knowledge of craniofacial anatomy, occlusion, and airway control can greatly aid in preventing and treating this condition. Still, there are difficulties, especially regarding the requirement for additional dental practitioners to undertake further training, patients' increasing awareness of OSA, and coordination with other healthcare professionals. Particularly in relation to alternative therapies, more investigation would help to clarify the effectiveness of dental treatments for OSA [6].

|| REVIEW

Pathophysiology and Risk Factors of Obstructive Sleep Apnea: Either pauses in breathing (apnea) or shallow breathing (hypopnea) result from obstructive sleep apnea (OSA). Typically characterized by intermittent upper airway constriction or collapse during sleep, this complex disease exists. These events define morphological, physiological, and neurological elements that combine to produce upper airway blockage. Often, a more severe collapse in rapid eye movement (REM) sleep occurs due to low muscle tone [7]. Among the contributing causes are anatomic anomalies, including either excessive soft tissue in the neck and lower muscle tone in the upper airway or a small or recessed jaw (retrognathia). Moreover, obesity is also important since neck fat accumulation aggravates blockage and raises airway resistance. The intermittent nature of these obstructions causes repeated cycles of low oxygen levels (hypoxemia) and high carbon dioxide levels (hypercapnia), which activate the body's compensatory systems, including increased sympathetic nervous system activity, elevated blood pressure, and a faster heart rate [8]. Over time, these systems increase the risk of heart disease, hypertension, and other severe medical conditions. While age, gender, family history, and anatomical features are non-changeable, obesity, smoking, alcohol intake, and physical inactivity are OSA risk factors. Though OSA is more common among males and older adults, hormonal changes also progressively impact postmenopausal women. OSA-related contributing variables worsen with nasal congestion and associated comorbidities, including diabetes and hypertension. Early diagnosis and efficient treatment of OSA depend on an awareness of the complicated interactions among these aspects, which also helps to avoid possibly serious health effects [9].

Diagnostic Approaches to OSA: If you have Obstructive Sleep Apnea (OSA), testing can determine if your airway is blocked while you sleep, assess its severity, and identify potential causes. The first steps typically involve a physical exam and a thorough review of the patient's medical history. During the initial assessment, doctors look for signs of pain or trouble concentrating. Some of these signals are loud snoring, proven apnea, being overly sleepy during the day, and other things. A physical exam often looks for structural problems in the upper airway that may be causing obstructive sleep apnea (OSA), such as being overweight, having a small jaw, or having large tonsils. The Epworth Sleepiness Scale is a test you take daily to assess your level of tiredness and determine whether you may have sleep-disordered breathing. It's one of the best ways to tell if someone has OSA [10].

A polysomnography (PSG) is the simplest technique to find out if you have obstructive sleep apnea (OSA). It often occurs in a sleep clinic. PSG examines various aspects of your body during sleep, including brain waves (EEG), eye movements (EOG), muscle activity (EMG), heart rate (ECG), breathing effort, airflow, and oxygen saturation. The apnea-hypopnea index (AHI) indicates to doctors the severity and frequency of apnea and hypopnea episodes. This helps them make sure that the diagnosis is OSA. Obstructive sleep apnea (OSA) happens when you feel tired during the day and experience five or more apneas or hypopneas every hour [11].

Home sleep apnea testing (HSAT) is an option for individuals who can't visit a laboratory for sleep tests or prefer a more convenient solution. The HSAT typically records only a few things while the patient is asleep at home. These sensors are small and can be moved. They keep track of how much air you breathe, how hard you breathe, and how much oxygen is in your blood. The HSAT isn't as mysterious or Socratic, but it can help identify mild to moderate OSA. It would overlook difficult situations, such as those caused by central sleep apnea or other sleep disorders. If you think you have OSA and don't have any other serious health problems that demand a more thorough checkup, you should have HSAT [12].

We need to learn more about what causes OSA and how it affects different sections of the body. Polysomnography (PSG) is a more complex and intrusive method for diagnosing obstructive sleep apnea (OSA). Oximetry, on the other hand, checks the amount of oxygen in the blood at night. If doctors think that problems with the body's structure are making it hard for air to move through, they may ask for more imaging tests, such CT scans or MRIs of the upper airway. We can now use nasal endoscopy to gain a close look at the pharyngeal airway and nasal passages, making it feasible to detect structural defects or blockages [13].

In the end, the personalized diagnostic plan typically includes a physical exam, objective tests, and an assessment of symptoms to determine if OSA is present, its severity, and potential causes. After that, people use this information to choose a treatment and how to deal with it.

The Role of Dentists in OSA Screening and Referral:

Dentists play a crucial role in identifying and treating Obstructive Sleep Apnea (OSA) at an early stage. In most cases, the first individuals to detect signs of a problem are dentists. Dentists are particularly skilled at identifying the physical and clinical signs of OSA that other doctors might overlook, as they have a deep understanding of the structure of the head and neck. Regular trips to the dentist can help identify indicators of tooth wear, bruxism (teeth grinding), dry mouth, and a higher risk of periodontal disease, all of which can make it difficult to sleep. Dentists can also examine craniofacial traits known to increase the risk of obstructive sleep apnea (OSA), such as a short or recessed jaw (retrognathia), large tonsils, or a high-arched palate [14].

The Epworth Sleepiness Scale and the STOP-Bang questionnaire are two examples of screening questionnaires that dental offices use to start OSA screening. These surveys help determine the likelihood that someone has sleep-disordered breathing. These tests search for common OSA symptoms, including daytime lethargy, loud snoring, and apnea, as well as risk factors such as being overweight or having high blood pressure. Suppose a patient performs well on these tests or displays additional indicators of OSA. In that case, dentists can expedite the diagnosis process by suggesting additional tests at home or polysomnography, or by referring the patient to a sleep expert [15].

Apart from early identification, dentists are quite useful for OSA therapy, especially for mild to moderate forms of the condition. Teaching dental appliance therapy, especially mandibular advance devices (MADs), which are custom-made equipment meant to move the lower jaw and tongue forward during sleep, so as to improve the airway size and lower resistance, is advised. Many people find a good replacement for CPAP utilizing these oral devices, especially those who find CPAP uncomfortable or unsuitable. Dentists must make necessary adjustments to ensure a proper fit, monitor the operation of these devices, and enhance performance and patient comfort [16].

Dentists also advise patients on lifestyle changes that might reduce OSA symptoms, like weight loss, side-of-sleep avoidance, and avoidance of alcohol or sedatives before bed. Although they do not offer primary care for OSA, dentists enhance the overall treatment for people with OSA by their ability to diagnose, test, and treat the disease in collaboration with other healthcare experts. Early detection of OSA symptoms and referral of patients to suitable experts would help dentists considerably improve patient outcomes and quality of life.

Oral Appliance Therapy is a primary treatment option in the dental management of Obstructive Sleep Apnea (OSA), particularly for patients with mild to severe cases who either cannot tolerate or prefer an alternative to Continuous Positive Airway Pressure (CPAP) therapy.

Using bespoke oral equipment comprising tongue forward during sleep and mandibular advancement devices (MADs), aimed to move the lower jaw (mandible). One helps to decrease airway collapse and therefore reduces apnea and hypopnea by assisting the upper airway to remain patent. Oral appliance therapy is a quick, non-invasive, and comfortable treatment that can significantly enhance overall health and sleep quality [17].

Designed largely to treat OSA, oral appliances shift the mandible forward. This movement opens the pharyngeal airways, particularly at the level of the tongue and soft palate, where obstruction usually arises during sleep. By pushing the mandible forward, these devices also help prevent the airway from closing and reduce apneic episodes, thereby enabling unrestricted airflow during sleep. For many people with additional OSA symptoms, including snoring, daytime sleepiness, and fatigue, oral devices can help improve their quality of life [18].

The acceptability of oral appliance treatment is a key advantage. Oral appliances are more pleasant and less disruptive than CPAP, which requires a mask attached to a machine that delivers constant airflow. Whether their CPAP is loud, uncomfortable, or hefty, many patients find adherence challenging. On the other hand, especially for those who travel regularly or prefer a more discreet option, oral appliances are smaller, more portable, and simpler to use. Oral devices also appear to be suitable for individuals with mild or positional obstructive sleep apnea (OSA), where the severity of the condition is less clear-cut and mechanical ventilation, such as continuous positive airway pressure (CPAP), is not necessary [19].

Oral appliance treatment depends on the equipment used, particularly to match the patient's oral anatomy. A sleep medicine specialist dentist takes perfect dental impressions of the teeth and jaw to create a personalized gadget that fits exactly in the mouth. The most often utilized equipment, since it gently moves the lower jaw forward to open the airways, is the mandibular advance device (MAD). Tongue retention devices (TRDs), which maintain the tongue forward, can sometimes help patients whose tongue collapses, potentially blocking their airways to a significant extent [20].

Patient compliance, the severity of obstructive sleep apnea (OSA), and the fit and comfort of the device all contribute to the effectiveness of oral appliance treatment. Frequent follow-up visits ensure the patient's responsiveness to the device, ensure proper fit, and enable necessary device modifications. Normally, with little change, some people may experience brief, unpleasant effects, including tooth sensitivity, jaw pain, or changes in bite over time; these can usually be managed [21].

Usually advised for those with mild to moderate OSA, oral appliance treatment is not suitable for those with severe OSA or those with special anatomical issues not addressed by oral appliances alone. More suited under these conditions would be another surgical operation or CPAP. For many patients, especially those who cannot tolerate CPAP or would rather have a more attractive option, oral appliance therapy offers an excellent solution [22].

Oral appliance therapy is, at last, a non-invasive and effective therapeutic option for treating obstructive sleep apnea (OSA) for people with mild to moderate symptoms specifically. By boosting airway patency, reducing apnea, and enhancing sleep quality, which in turn improves patient quality of life and subsequent health outcomes, these devices have a profound impact. Dentists are thus crucial in the diagnosis, fitting, and maintenance of mouth appliance treatment for patients with obstructive sleep apnea, as they offer a necessary therapy.

Orthodontic Interventions: Aiming to address OSA, orthodontic treatments focus on repositioning the teeth and jaw to open airways and prevent airway collapse during sleep. Commonly used orthodontic therapy is maxillomandibular advancement (MMA), also known as functional appliances, which are used to position the upper and lower jaws (maxilla and mandible). These devices serve to open the airways and clear obstructions caused by a small or recessed jaw (retrognathia) by gradually expanding the jaw forward. Usually used in developing adults or those with mild to moderate obstructive sleep apnea (OSA), functional appliances include Twin Block or Herbst appliances. Long-term benefits result from these devices, which help increase airway room and improve jaw alignment [23].

Patients with a narrow maxillary arch may exhibit broadening of their upper jaw and rapid maxillary expansion (RME). Typically, younger individuals whose skeletal bones are still growing use RME, as it can expand the nasal and oral airways. This surgery expands restricted airways that are constrained by a small upper jaw. Mandibular advancement devices (MADs) or occlusal splints are also indicated as an adjuvant to orthodontic treatments, especially for people with mild to moderate obstructive sleep apnea (OSA). These devices slightly forward the jaw, therefore reducing airway constriction during sleep [24].

Orthodontic treatments are especially used in tandem with other therapies, including oral appliance therapy, especially for people with obstructive sleep apnea (OSA) brought on by malocclusions or jaw misalignments. For people with severe OSA, however, orthodontic therapies by themselves may not be sufficient; a more all-encompassing approach incorporating surgical procedures may be needed.

Surgical Interventions: Usually reserved for patients with extreme OSA or those refractory to CPAP or other non-invasive treatments, surgical procedures are available. Surgery aims to permanently alter the shape of the upper airway to eliminate or reduce the factors that cause airway blockage during sleep. The specific condition of the patient will influence the surgical decisions; the operations can aim at soft tissues or bone structures of the upper airway [25].

One of the most widely utilized and effective surgical procedures for OSA, Uvulopalatopharyngoplasty (UPPP) involves the removal of excess soft tissue from the uvula, soft palate, and throat. This operation is designed to remove excess or bulky tissue from the neck, thereby reducing airway obstruction. While UPPP can benefit some individuals, it is not always effective in treating severe OSA, especially in cases where structural issues in the jaw or nasal airways significantly contribute to airway collapse [26].

Patients with more severe jaw malformations can have maxillomandibular advancement (MMA) surgery. This operation advances both the upper and lower jaws forward to broaden the airway and enhance breathing during sleep. MMA is highly effective in treating severe OSA and has been shown to provide long-term relief, as it targets the underlying cause of airway obstruction. Sometimes, this operation is seen as a last resort when various therapies, including CPAP and oral appliances, have not been successful [27].

When OSA occurs from nasal congestion or chronic sinus difficulties, nasal surgery may be called for. Procedures, including rhinoplasty (surgical reshaping of the nose) or septoplasty (correcting a deviated septum), can improve nasal passage airflow and reduce the overall load of airway resistance. Usually carried in conjunction with other treatments, such as CPAP or oral appliance therapy, nose procedures increase their effectiveness [28].

Another surgical option for OSA is genioglossus advancement (GA), in which the muscle controlling tongue movement is moved to prevent lower airway collapse near the base of the tongue. Usually paired with other operations, including UPPP or MMA, this procedure provides a comprehensive solution for severe OSA [29].

Pediatric Considerations: Young children with pediatric obstructive sleep apnea (OSA) exhibit distinct symptoms compared to adults. Children may exhibit loud snoring, coughing, or gasping while asleep, as well as excessive daytime sleepiness, bedwetting, trouble focusing, behavioral problems such as hyperactivity or irritability, and poor academic achievement. OSA in children is commonly overlooked or misdiagnosed, but these symptoms resemble those of other common pediatric disorders like attention-deficit hyperactivity disorder (ADHD). Parents and caregivers should be aware that their child either consistently sleeps during the day or struggles to stay awake at school; these issues may be related to other factors that contribute to diagnosis delay [30].
The diagnosis of obstructive sleep apnea (OSA) in children is similar to that in adults, typically involving a comprehensive medical history, physical examination, and the use of screening instruments, such as the Children's Sleep Questionnaire. Should OSA concerns develop, the gold standard for diagnosis validation is a polysomnography (PSG) sleep study. Though polysomnography (PSG) remains the most thorough technique, especially in children with complex obstructive sleep apnea (OSA) presentations, in some circumstances, home sleep apnea tests (HSATs) may also be performed [31].
Typically, pediatric OSA treatment begins with addressing the primary anatomical cause of airway blockage. Often, the removal of the tonsils and adenoids, known as adenotonsillectomy, is highly beneficial in reducing the severity of OSA and providing symptom relief. Children with larger tonsils and adenoids tend to benefit more from this surgical procedure; individuals with regular sources of airway obstruction also benefit from it. Many children with obstructive sleep apnea (OSA) can be treated by adenotonsillectomy, thereby improving their sleep quality and reducing concomitant behavioral and cognitive issues [32].

Children who are not candidates for surgery or in instances when surgery does not totally solve the problem could require further treatments. Often used in adults, Continuous Positive Airway Pressure (CPAP) treatment is also beneficial for children with moderate to severe OSA, especially when surgery is not an option or when the child has other risk factors such as craniofacial deformities or neuromuscular diseases. By using a machine that constantly runs air through a mask, CPAP opens the airways during sleep. Although many children find following CPAP therapy difficult, many of them could adapt to its use with suitable guidance and assistance [33]
In cases when surgery and CPAP are inappropriate or ineffective, notably for children with mild to severe OSA and some craniofacial anomalies, oral appliances aimed at addressing the lower jaw and tongue could be a solution. Usually used in children with less severe anatomical defects, these devices advance the jaw and help alleviate airway tightness [34].
Apart from these pharmacological therapies, drastically lowering pediatric OSA depends on completely changing the lifestyle. Given that obesity is a recognized risk factor for OSA, particularly in older children, weight control can be particularly important. Reducing this risk will depend on adopting a healthy diet and engaging in regular physical exercise. Apart from helping to lower symptoms, avoiding allergens and irritants that aggravate nasal congestion, and encouraging children to sleep on their sides instead of their backs, would aid [35].

Ultimately, pediatric obstructive sleep apnea (OSA) necessitates thorough research into the specific factors contributing to airway blockage in children, as well as a personalized approach to diagnosis and treatment. Depending on the severity of the condition and the child's specific needs, other therapies, including continuous positive airway pressure (CPAP), oral appliances, and lifestyle changes, may be necessary, even if adenotonsillectomy remains the most effective treatment for children with enlarged tonsils and adenoids. Early diagnosis and therapy especially help to prevent the long-term consequences of untreated OSA on a child's general well-being, growth, and development.

||DISCUSSION

Particularly in the treatment of Obstructive Sleep Apnea (OSA), oral sleep medicine has recently demonstrated significant expansion and improvement, primarily associated with mouth devices. Still, in the broader field of study, as well as in the practice of dental sleep medicine, there are significant limitations and challenges to their capacities and increasing popularity. These challenges are related to the difficulty of OSA diagnosis, the limitations of current treatment options, and the need for greater coordination between dental practitioners and other medical specialists [36].

One of the key challenges in dental sleep medicine is accurately diagnosing obstructive sleep apnea (OSA) in some individuals. Although dentists are rather adept at identifying early OSA signs, including bruxism, tooth wear, and other craniofacial abnormalities, the conclusive diagnosis of OSA usually calls for more comprehensive sleep studies, such as polysomnography (PSG) or home sleep apnea testing (HSAT). [37]. Especially in areas where sleep experts are scarce, these diagnostic instruments could not always be readily available and resource-efficient. Moreover, even if less comprehensive and may not reveal more complex OSA events, such as central sleep apnea or those involving various types of airway blockage, home sleep studies are more practical and less expensive. This may lead to underdiagnosis or misdiagnosis, therefore complicating treatment strategies and outcomes [38].

Still more limitations relate to the consistency and success of dental appliance treatment. Mandibular advance devices (MADs) have shown effectiveness for many persons with mild to moderate obstructive sleep apnea (OSA); nonetheless, they may not be enough comfort for those with more severe forms of the condition or those with apparent anatomic anomalies [39]. Moreover, issues with patient comfort, device fit, and long-term adherence may still arise, even if oral appliances are generally considered superior to CPAP equipment. Patients experiencing side effects, such as tooth movement, jaw pain, or bite irregularities, may find their willingness to continue treatment compromised. The degree of OSA, patient compliance, and dental proficiency in fitting and adjusting the device all contribute to the success of oral appliances [4].

Cooperation among dental practitioners and other medical experts provides still another challenge. Although they are significant in the diagnosis and treatment of OSA, particularly in terms of early symptom detection and oral appliance therapy, their influence is often not fully integrated into the larger healthcare system. Many OSA patients have concurrent conditions such as diabetes, heart disease, or hypertension that demand coordinated treatment among sleep experts, pulmonologists, cardiologists, and primary care doctors. Maintaining comprehensive and effective therapy depends on the development of multidisciplinary communication and teamwork. Furthermore, more consistent rules for OSA control and screening in dental offices are required, as the current approach is not universally accepted by professionals [35].

Looking forward, dental sleep medicine presents numerous opportunities for growth and development. The development of more tailored and effective therapy strategies for obstructive sleep apnea (OSA) should thus be the primary focus of further investigations. Technological advancements could lead to the use of more modern diagnostic tools in dental offices, as well as the development of more sophisticated mouth appliances. More precise adjustments and improved patient compliance will help enable the development of smart oral appliances that monitor sleep patterns, airway blockage, and device efficacy in real-time, thereby improving therapy outcomes. Moreover, studies on combination therapies, that is, combining oral appliances or lifestyle changes with CPAP, may provide patients with moderate to severe OSA a more complete and effective management option [41].

Future research must thus largely concentrate on the long-term effectiveness of dental appliance treatment. Although studies have demonstrated that MADs can significantly reduce OSA symptoms and improve patient quality of life, more comprehensive, long-term research is needed to fully understand their impact on cardiovascular health, cognitive function, and overall health outcomes, especially. Understanding the various long-term risks and benefits of dental instruments helps one to develop direct therapy strategies and recommendations [42].

Furthermore, it is highly important to note the increasing knowledge and training that dental practitioners acquire. Dentists should be particularly familiar with the latest developments in sleep medicine, which include understanding the rationale behind dental appliance therapy, the proper fitting and adjustment of devices, and the ability to recognize and diagnose OSA symptoms early on. Through improved training and certification programs for dentists, the overall quality of care provided to patients can be enhanced, and knowledge of obstructive sleep apnea (OSA) can be increased. Better cooperation among dentists, sleep experts, and other healthcare professionals arising from this would help to ensure that patients receive speedy and successful treatment [43].

Public awareness of the link between sleep apnea and dental health is at last somewhat significant. More awareness campaigns could motivate individuals to seek dental care early, as many still lack knowledge that their dental condition may be related to their disturbed breathing. Early treatment is crucial to prevent the more severe consequences of untreated OSA, including lower cognitive capacity and cardiovascular problems [44].

|| CONCLUSION

Although dental sleep medicine has considerable potential in the diagnosis and treatment of OSA, several problems, including diagnostic limitations, treatment efficacy, patient adherence, and interdisciplinary teamwork, must be addressed. Constant research and innovation in both therapeutic and diagnostic spheres will determine the direction of the profession's future development. Through considerably better management of OSA via increased cooperation between dental specialists and other healthcare providers, the creation of alternative treatments, and enhanced patient education, patients can expect improved health outcomes and a higher quality of life.

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