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Obstructive Sleep Apnea and Braces

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Abstract: **Obstructive sleep apnea (OSA) causes people to feel tired because they are not getting enough sleep. This is because they are constantly woken up by loud snoring and pauses in breathing while they sleep. Screening for OSA and referring patients at risk to sleep physicians is a service that orthodontists are well-suited to provide. In treating OSA, physicians (including advanced practice providers supervised by physicians) may prescribe orthodontic appliances or procedures to appropriately selected adults. A patient's orthodontic condition contributing to their OSA will determine which of three specialized dental appliances their orthodontist will recommend. First, braces and aligners can be used to treat misaligned teeth caused by OSA. As a non-invasive treatment option, oral appliance therapy is frequently prescribed to OSA patients. The recommended oral appliance is a customized, titratable mandibular advancement device (MADs) that permits progressive mandibular protrusion. Despite the superior effectiveness of CPAP in reducing OSA severity, recent studies have revealed that CPAP and MADs therapy have comparable health outcomes. This is likely due to greater nightly MADs compliance compared to CPAP therapy. OSA is, in the majority of cases, a chronic disorder. Because OSA is a complex disorder with multiple facets, the most effective treatments are comprehensive and interdisciplinary. The sleep team, which includes an orthodontist and a sleep dentist, should not be alarmed by the trial-and-error nature of OSA treatment.**

Keywords: **Obstructive sleep apnea, sleep-disordered breathing, orthodontic sleep apnea, oral appliance titration.**

I. INTRODUCTION

Obstructive sleep apnea (OSA) presents symptoms such as drowsiness from lack of sleep due to continuous disruptions during sleep, which is caused by overly audible and (disruptive) snoring, and apnea when sleeping [1]. These actions lead to disintegrated and (nonrestorative) sleep and thus can affect quality of life, health, like heart issues, and daily tasks, like driving [2]. The characteristics of OSA are the decrease of oxygen saturation by the narrow airway affected by the reduced size of the airway completely, or partially [3, 4]. OSA in children and adults is one of the sleep-related breathing disorders managed by the dental practice field [5]. Dental treatment options can differ considering the causation of the apnea and age progression [2]. Treatments such as non-surgical maxillary expansion and orthodontic functional appliances may be given to children while the treatment procedures for adult patients may consist of oral appliance therapy (OAT), orthognathic surgery, and surgical or miniscrew supported palatal expansion [6, 7]. The importance of dentistry, especially orthodontics, regarding the management of these disorders about the possibility of having to do with both the oral cavity and systemic health are oblivious to a number of doctors and dentists [8]. This review article is an attempt to compile evidence-based relevant information on the role of orthodontists in the screening, diagnosis, and management of sleep apnea.

II. PATHOPHYSIOLOGY OF OSA

Sleep apnea happens as a result of insufficient airflow, from the lack of space in a part of the upper airway, during sleep [9]. The effect of the reduced muscle tone is a repetition of total or partial collapse of the airway. While enlarged tonsils and/or adenoids is the most common cause of OSA in children, in adults, obesity, male sex, and advancing age is most commonly associated [10, 11]. People with OSA have impairment in the function of a muscle tongue, genioglossus muscle [12, 13]. This results in the prolapse of the tongue against the posterior pharyngeal wall, closing and blocking the airway, during the effort in relation to respiratory activities while sleeping [12, 14]. Obstruction in nasal airflow makes attempts to do respiratory related activities become harder and raise the negative pressure in the pharyngeal airway, the chances of the collapse of the airway increases as the outcome [15].

III. SLEEP-DISORDERED BREATHING (SDB)

Sleep-disordered breathing is a blanket term that includes a range of chronic conditions from primary snoring (PS), which appears to be the least intense, and obstructive sleep apnea (OSA), being the most intense [16]. Primary snoring is the lessening in the upper airway (UA) causing tissue vibrations without halting the breathing [17]. Alternatively, OSA is the collapse of the upper airway, causing the complete or partial cessation of breathing, apnea or hypopnea, respectively, many times during the night [18, 19]. According to the available evidence, OSA is an independent risk factor for cognitive dysfunction, metabolic disorders, and cardiovascular illness, including hypertension, cardiac arrhythmias, heart failure, ischemic heart disease, and stroke [20, 21]. It was shown that the pathophysiology of these effects is connected to what occurs during OSA respiratory episodes, including intermittent hypoxia, oxidative stress, an increase in sympathetic activity, and endothelial dysfunction [22, 23]. OSA was shown to be an underdiagnosed disorder [24]. The incidence of OSA has been increasing [25]. In Saudi Arabia, 5% of women and 12% of males are reportedly affected by OSA. Orthodontists and sleep dentists may play an essential role in the screening and multidisciplinary treatment of these problems [26].

IV. CAUSES OF OSA

Orthodontists are ideally suited to undertake OSA screening evaluations and refer at-risk patients for diagnostic examination [10, 27]. As part of the therapy of obstructive sleep apnea (OSA), physicians (including advanced practice providers overseen by physicians) may prescribe orthodontic appliances or procedures to adequately chosen adult patients [28, 29]. In addition to muscle-related reasons, this kind of obstructive sleep apnea can also be caused by an orthodontic condition [30]. In certain people, the airway is restricted not by abnormalities in the throat muscles but by orthodontic disorders such as tooth misalignment, jaw misalignment, and dental arch trouble [31]. When an orthodontic problem is the cause of sleep apnea, a sleep apnea dental device must be prescribed by an orthodontic specialist [26, 32].

V. TREATMENTS OF OSA

An orthodontist may propose one of three special dental appliances for obstructive sleep apnea, depending on the specific orthodontic condition underlying a patient's obstructive sleep apnea [33]. First, braces and aligners can treat misaligned teeth for obstructive sleep apnea. These devices shift teeth out of their erroneous placements and into positions where they will not obstruct the airway in a gradual but deliberate manner [5]. Braces and aligners can be used to treat sleep apnea in children and adults, but aligners are less evident than braces [32].

Second, a fast palate expander is occasionally used to treat children with obstructive sleep apnea [31]. A fast palate expander aims to enlarge the upper jaw space [10]. The appliance is cemented or bonded to the upper molars and has a part that spans the top jaw [34]. Third, mandibular advancement [34]. A splint is a custom-fitted brace that alters the posture of the jaw while sleeping [34]. The gadget gently advances the lower jaw forward and downward [10, 11]. This tiny movement expands the airway, which minimises the occurrence of sleep apnea symptoms [28]. When an orthodontist determines that a dental device for sleep apnea is acceptable, the appliance will offer significant advantages over a CPAP machine [35, 36]. Braces, aligners, short palate expanders, and mandibular advancement splints are smaller, less conspicuous, and quieter than the machines [37]. In certain circumstances, a dental appliance for sleep apnea may gradually replace the need for a CPAP machine, but it is sometimes necessary to use them in conjunction with a CPAP machine [7, 38].

VI. ORAL DEVICES OF SLEEP APNEA

Oral sleep aids are the most popular alternative to PAP devices [39]. According to reports, oral sleep devices are well tolerated and adhered to. High adherence was indicated subjectively through self-reports and validated objectively using microsensors to monitor adherence [38]. Oral appliance therapy is widely recommended as a non-invasive treatment option for obstructive sleep apnea sufferers [40]. Mandibular advancement devices (MAD) that are customisable and titratable are the suggested types of oral appliances [41]. Despite the fact that mandibular advancement devices can effectively reduce obstructive sleep apnea severity, the continuous favorable airway pressure treatment (CPAP) is more effective [42, 43]. While in most patients, it is established that oral appliance therapy reduces the severity of obstructive sleep apnea, one in three people exhibits no change with MAD therapy [44, 45]. Based on their manner of action, oral appliances may be classified into three groups [46, 47]. First, soft palate lifters try to decrease soft palate vibrations by raising the soft palate and uvula. However, there is scant evidence that they are effective [15]. Second, tongue retention devices (TRD) employ suction pressure to maintain the tongue forward, keeping it from slipping back into the pharyngeal airway during sleep [17]. The third group consists of oral equipment, known as mandibular advancement devices (MADs), mandibular advancement appliances (MAAs), mandibular repositioning appliances (MRAs), or mandibular advancement splints (MASs) that advance

the mandible and tongue during sleep [3]. The most prevalent form of oral appliance therapy utilized to treat OSA is the MAD [48]. Generally, it is considered that the MAD's mechanism of action enlarges the cross-sectional dimensions of the upper airway via anterior displacement of the mandible and the connected tongue, as a result, the patency of the upper airway becomes greater [48]. There is a vast selection of commercially available MADs, each with unique design characteristics [15]. MADs can be prefabricated or bespoke thermoplastic devices. Dental impressions of the patient's teeth and bite registration by the dentist are used to create custom-made dental equipment. The thermoplastic or "boil and bite" appliances, which may be fitted without the requirement for plaster casts or bite registrations, are a less expensive option [49]. A randomized controlled experiment regarding the comparison of effectiveness between a thermoplastic device and a custom-made appliance offered vital evidence that a prefabricated MAD is less effective than a custom made MAD in lowering the severity of OSA [7]. Thus, custom-made thermoplastic devices are preferred over prefabricated thermoplastic devices [32]. In addition, the idea of custom-made MADs has progressed from the "monobloc" device type, in which the top and lower halves were permanently attached, to the present "duobloc" varieties [7]. The inflexible monobloc MADs inhibit mandibular mobility, causing TMJ pain on occasion [50]. As the top and bottom halves of the so-called titratable MADs are distinct yet dynamically coupled, the mandibular advancement may be adjusted precisely [51].

A randomized controlled experiment indicated that a thermoplastic heat-molded titratable MAD was comparable to a custom-made acrylic MAD over the short term [52]. Consequently, such a thermoplastic titratable MAD can be utilized as a simple, inexpensive, and ready-to-use approach for identifying individuals likely to benefit from long-term MAD therapy [53]. According to the scientific literature, the degree of protrusion is crucial in enhancing MAD effectiveness [54]. However, more protrusion does not necessarily provide better outcomes [3]. Consequently, the appropriate mandibular protrusion for MAD treatment must be determined for each patient and then changed based on tolerability and effectiveness [55]. However, there is currently no accepted standard for determining the appropriate MAD protrusion [17]. The majority of MAD treatment outcome studies employ a so-called "subjective titration technique" that relies on not only the physical limitations of the patient's mandibular protrusion, but the self-reported progression of symptoms, such as snoring and daytime drowsiness [56]. However, such subjective improvement in symptoms may not be the most reliable signal for adequate titration of the MAD: it may result in a poor treatment outcome, as the reduction of subjective complaints may induce premature titration cessation [36]. In a manner akin to a CPAP titration night, the mandible can be gradually advanced each time a respiratory event occurs during sleep. In nocturnal sleep tests, a so-called "remotely controlled mandibular positioner" (RCMP) was used to identify the ideal mandibular protrusion for MAD therapy in individual patients [42]. The literature demonstrates that RCMP titration reduces OSA severity more than standard titration approaches. Consequently, MAD titration remains a "trial and error" procedure [55]. In addition, there is debate in the scientific literature on the potential role of vertical opening [18]. The structural elements of each MAD cause the mandible to be concurrently positioned in a more caudal orientation, increasing the inter-incisal distance or vertical dimension [12, 57].

VII. TREATMENT FOR DENTAL APPLIANCES AND ORAL APPLIANCE TITRATION

Oral appliances, which include mandibular advancing oral appliances (OAms) and tongue-retaining devices, are often valuable choices for OSA therapy in individuals who are correctly selected [53]. OAMs are designed to hold the jaw or the accompanying soft tissues forward, resulting in a more prominent upper airway at the level of the oropharynx [2, 58]. A significant amount of evidence supports the use of OAs for OSA patients [7]. In particular, OAs may be utilised to treat mild to moderate OSA and severe OSA in individuals who are reluctant or unable to employ PAP therapy [47]. The American Academy of Sleep Medicine and the American Academy of Dental Sleep Medicine have published recommendations describing how OAs fit into the OSA management paradigm [59]. Functional appliances and OAMs are the first-line treatments for OSA patients who choose OAs over PAP therapy and those who do not react to PAP therapy [26]. It should also be noted that not all individuals with OSA respond to OAM treatment [60]. This type of therapy is successful in 36–70% of OSA cases [26]. Numerous forms of OAs are used to treat OSA in adults [61]. The appliances differ depending on the connection design, construction and activation, titration capability, degree of vertical opening, lateral jaw movement, and whether they are prefabricated or custom-made. Suitable indicators for each design should be taken into account [48, 62].

Initial placement of oral appliances involves advancing the mandible to approximately two-thirds of maximal protrusion [23]. After adaptation, the degree of protrusion can be titrated or increased until optimal symptom alleviation is achieved, based on the patient's subjective feedback about OSA symptoms and sleep quality [56]. The orthodontist may employ unattended (type 3 or 4) portable monitors to determine the best goal position of the mandible. The physician will often recommend a sleep study with the OAM in place [63].

VIII. CONTRAINDICATION OF ORAL APPLIANCE TREATMENT (OAT)

Oral appliance treatment (OAT) side effects may be temporary or permanent. Pain may arise from the teeth, the temporomandibular joint (TMJ), or the muscles of mastication as a short-term side effect [51]. Other possible short-term adverse effects include irritating soft tissues, dry mouth, excessive salivation, and anxiety due to the device [55]. These adverse effects may be temporary or long-lasting, primarily if they are not handled promptly and appropriately [63]. With prolonged usage of oral sleep aids, occlusal abnormalities may develop. The most commonly observed occlusal alterations include a reduction in overjet and overbite; proclination of the lower incisors; retroclination of the upper incisors; a posterior open bite; and the formation of interproximal gaps, particularly between the lower posterior teeth [41]. It is suggested to employ a morning occlusal guide, also known as a morning re-positioner, to reduce occlusal alterations with long-term usage of the OAT [50]. The fabrication of this guide is based on the patient's initial occlusal relationship prior to OAT start [23, 51]. The goal of the morning appliance is to restore the mandible to its pre-OAT position and reverse any tooth position modifications that may have occurred [5, 55].

IX. MONITORING

During OSA therapy, the patient should be monitored, including both subjective and objective monitoring [39]. The patient and bed partner or carer may provide reports on OA utilisation [43]. Compliance should be assessed, and the device should be examined for fit and comfort, the need for titration, and the emergence of adverse side effects [26]. Most current statistics on adherence to OA treatment are based on subjective reports [50]. A temperature sensor has been investigated to get objective measurements of OA adherence, although such measurements are not now part of standard clinical treatment [7]. During the first year, monitoring should be undertaken at least once every six months and yearly [45]. Due to routine monitoring, the physician and orthodontist should communicate routinely [64]. A visit with the physician is strongly advised if the patient's OSA-related symptoms worsen or their general health changes [2, 36, 65].

X. CONCLUSION

Patients with OSA are frequently prescribed oral appliance therapy as a non-invasive therapeutic option. The suggested oral appliance is a customised, titratable mandibular advancement device that permits progressive mandibular protrusion. Despite the superior efficacy of CPAP in lowering OSA severity, recent studies have revealed equivalent health outcomes between CPAP and MAD therapy. This is presumably due to better nightly MAD adherence compared to CPAP treatment. MAD treatment lowers OSA severity in most unselected OSA patients, leaving around one-third with no improvement. In order to maximise the overall success of the treatment, screening suitable patients for MAD therapy is a continuous process. Several prediction methods have been offered to date, but there is no proven method that can accomplish an accurate and dependable upfront selection of the appropriate patient for MAD treatment. In the majority of situations, OSA is a chronic disorder. Because OSA is a complicated, multifaceted disorder, the most successful treatment approaches are comprehensive and interdisciplinary. The trial-and-error aspect of OSA care should not frighten the sleep team, including the orthodontist and sleep dentist.

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