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Modified Mono-Block Device for Treatment of Mild to Moderate Obstructive Sleep Apnea: Case Report and Overview

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ABSTRACT

Obstructive sleep apnea is a prevalent sleep disorder that leads to breathing pauses during sleep, causing symptoms such as tiredness, irritability, and fatigue. Various treatment options are available, including behavioral management, CPAP machines, oral devices, and surgery. The New Modified Mono-Block (MMBA) has demonstrated effectiveness and versatility in treating OSA patients and boasts its advantages over previously used devices. It is essential to seek medical advice if experiencing any symptoms of sleep apnea, and long-term treatment use can significantly improve symptoms and prevent potential complications.

Keywords

Sleep Apnea, Snoring, Oral Appliance Therapy, CPAP.

Introduction and Literature Review

Obstructive sleep apnea is a prevalent sleep disorder where breathing stops and starts repeatedly, lasting for 10 seconds or more while sleeping. This occurs due to relaxation of the posterior pharyngeal musculature and intermittently blocks the airway during sleep [1] causing hypoxia, hypercapnia, and respiratory acidosis. In severe cases, it can lead to cardiac arrhythmias and sudden death [2] Monitoring of breathing patterns includes the number of apnea and hypopnea episodes per hour, the apnea/ hypopnea index, or AHI. In adults, a AHI is considered normal if the score is five or less, a score of 5-15 indicates mild OSA, 15-30 is considered moderate, and a AHI above 30 is considered severe.

Obstructive sleep apnea can cause several symptoms, including excessive daytime sleepiness, loud snoring, and observed episodes of stopped breathing during sleep. Other symptoms may include abrupt awakenings accompanied by gasping or choking, awakening with a dry mouth or sore throat, morning headache, and difficulty concentrating during the day. It's important to talk to a doctor if you experience any of these symptoms to determine if further evaluation is necessary.

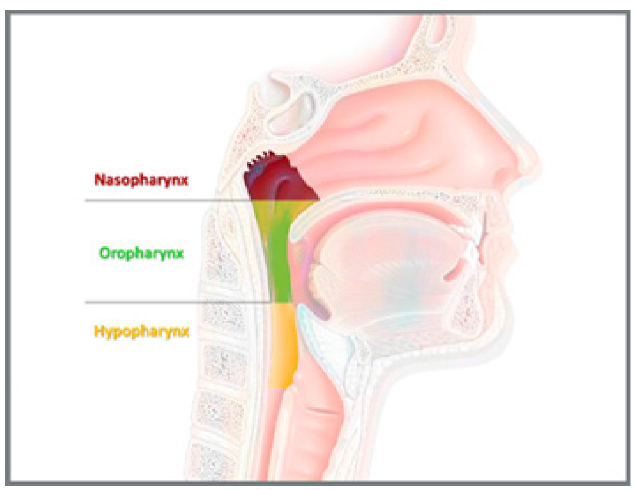


Figure 1: Upper airway, with areas of the nasopharynx (between skull base and hard palate), oropharynx (soft palate to the upper border of the epiglottis), and hypopharynx or laryngopharynx (from the tongue base to the lower border of the cricoid cartilage) (Juan Martin Palomo, 2023).

Obstructive sleep apnea is often characterized by snoring, which is a common symptom. Snoring affects a significant number of people, with around 40% of women and 60% of men in middle age experiencing it. It can occur in individuals of all age groups, with 2% of children, 2% of women, and 4% of men being affected by it.

Working alongside the medical sleep community, the dental field plays a vital role in managing obstructive sleep apnea and snoring disorders. Dentistry's primary contributions in treating OSA and its associated complications include the use of oral appliances, maxillary expansion, and mandibular or maxillo-mandibular surgery. Dentists can work with sleep physicians and other healthcare providers to provide patients with comprehensive treatment plans tailored to their individual needs. Bradley and Floras [3] noted that; although there are different types of sleep apnea; the most common one is obstructive sleep apnea. Another type is Central Sleep Apnea, which is less common and is usually linked to congestive heart failure (CHF) due to increased sympathetic activity and elevated left ventricular after-load. They suggest that continuous positive airway pressure is a promising non-pharmacologic adjunctive therapy for patients with CHF and coexisting sleep-related breathing disturbances that warrants further investigation. Further, they recommended in severe cases, oral appliances can be considered as alternative to continuous positive airway pressure devices (CPAP) for patients who cannot tolerate CPAP therapy.

According to Qseem et al. [4] literature review on obstructive sleep apnea (OSA), the management strategies recommended are as follows: 1. Strongly recommend encouraging overweight and obese patients to lose weight, 2. Strongly recommend using continuous positive airway pressure (CPAP) treatment as initial therapy 3. Mandibular advancement devices can be considered as an alternative therapy to CPAP for patients diagnosed with OSA who prefer them or who experience adverse effects associated with CPAP treatment.

In 2006, Ferguson et al. [5] conducted a review of existing literature to evaluate the effectiveness and side effects of oral appliances in treating snoring and obstructive sleep apnea (OSA). They found that oral appliances were successful in reducing the apnea-hypopnea index (AHI) to 10 or less per hour in an average of 52% of patients. Although minor tooth movement and occlusal changes were common, major adverse events did not occur. The study also found that patients preferred oral appliances over continuous positive airway pressure (CPAP) therapy, although the latter was found to be more efficient. Additionally, the review found that oral appliances were more beneficial than uvulopalato-pharyngoplasty, a surgical procedure used to treat snoring and OSA. Overall, the study concluded that there was sufficient evidence to support the efficacy of oral appliances in treating OSA.

One study involving 14 children with OSA found that after receiving RPE treatment, their AHI decreased, and their symptoms disappeared over a two-year follow-up period [6]. In another study by Cistulli et al. [7] involving 10 adults with an average age of 27 years, the Rapid Palatal Expander device was found to lower their AHI from a baseline of 19 to 7 in the group and seven patients achieving normal AHI of less than 5. Additionally, 9 out of 10 patients reported improvement in both daytime sleepiness and nighttime snoring.

Snoring Disorder

Snoring is a low-frequency, predominantly inspiratory noise caused by soft-tissue vibration in the pharynx during breathing. The sound of snoring occurs when there is not enough air flowing smoothly through the nose and throat while sleeping, leading to vibrations in the pharynx walls. This can be caused by a range of factors, such as airway obstruction, enlarged tonsils or adenoids, a relaxed soft palate, an elongated uvula, micrognathia, retrognathia, or obesity. Primary snoring, on the other hand, is narrowing in the UA leading to vibrations of tissue without cessation of breathing [8].

It's important to recognize that snoring can have serious health implications, even if it is not associated with sleep apnea. For example, snoring has been linked to atherosclerosis of the carotid artery. Additionally, bed partners of snorers may lose up to an hour of sleep per night and may even choose to sleep in separate rooms. Therefore, snoring should be treated as a significant health concern [9].

Medical and Sleep History

In addition to secondary hypertension, OSA can also cause congestive heart failure, stroke, and coronary artery disease. Intermittent hypoxia resulting from OSA can contribute to secondary hypertension through sympathetic nervous system hyperactivity, increased renin-angiotensin system activity, and oxidative stress. Ultimately, these medical complications can lead to all-cause mortality, underscoring the importance of early diagnosis and effective treatment of OSA [10,11].

In addition to the previously mentioned complications, OSA has also been associated with the development of atrial fibrillation and sudden cardiac death and can contribute to the progression of heart failure. OSA is also an independent risk factor for diabetes mellitus and addressing both obesity and OSA can help to reduce their severity [12] notably; nocturnal oxygen desaturation caused by OSA has been linked to an increased risk of atrial fibrillation and sudden cardiac death in individuals under the age of 65 [13,14].

OSA can lead to several complications, including heart failure, through various mechanisms such as intermittent hypoxia, sympathetic nervous system hyperactivity, and oxidative stress. Treating OSA can help reduce the risk of developing these complications and improve overall health outcomes. It's important for individuals with suspected OSA to seek proper diagnosis and treatment from qualified healthcare professionals [15]. The presence of OSA, even in the absence of other cardiovascular conditions, can contribute to cardiovascular damage and dysfunction. Additionally, studies have shown that moderate to severe OSA is independently associated with a higher risk of all-cause mortality. Therefore, early diagnosis and treatment of sleep apnea are crucial in preventing potential medical complications and improving overall health outcomes.

Obesity and OSA are both prevalent conditions and are interrelated. Treatment of obesity can help reduce the severity of OSA and treating OSA can help reduce obesity [16]. Additionally, studies have shown that moderate to severe OSA is a risk factor for developing diabetes mellitus. This is likely due to the intermittent hypoxia and reduced sleep duration experienced by OSA patients, which can negatively impact glucose metabolism through multiple mechanisms, including increased sympathetic nervous system activity, dysregulation of the hypothalamic-pituitary axis, endothelial dysfunction, changes in cytokine and adipokine levels, and sleep disruption [17].

Examination and Diagnosis

The diagnosis and monitoring of OSA and Primary Snoring (PS) should be carried out by sleep physicians, according to the clinical practice guidelines issued by the American Academy of Sleep Medicine (AASM) and the American Academy of Dental Sleep Medicine (AADSM) [18].

Diagnosis of OSA is typically made by a sleep disorder specialist or a sleep medicine physician, using diagnostic tests such as polysomnography or home sleep apnea testing [19]. Several studies noted that weight loss and weight gain have been associated consistently with decreasing and increasing OSA severity [18,20]. Orthodontists and dentists can play an important role in the treatment of OSA by providing oral appliances that can help keep the airway open during sleep. However, it is important for them to work in close collaboration with the patient's sleep physician to ensure that the treatment is safe and effective. The sleep physician will also be responsible for monitoring the patient's condition and adjusting treatment as needed.

To reiterate, the sleep physician will first examine the patient for physical signs of OSA such as nasal, oropharyngeal and hypopharyngeal obstruction, obesity, and abnormal neck diameter. If the physician suspects the patient has OSA, they may prescribe a sleep study. The sleep study can take the form of a home sleep study or a nocturnal polysomnography at a sleep center. During a nocturnal polysomnography, the patient will spend the night at the center and be hooked up to a polysomnogram machine that monitors various bodily functions during sleep such as heart rate, breathing patterns, brain activity, and blood oxygen levels. This data is then analyzed by a sleep specialist to make a diagnosis and determine the severity of the OSA.

Treatment of OSA

The severity of OSA determines the course of treatment:

1. For mild OSA, sleep physicians usually recommend lifestyle changes, such as sleeping on your side instead of your back.
2. Weight loss and quitting smoking are recommended.
3. Tranquilizers, narcotics, sedatives, sleeping pills, anti-anxiety medications and alcohol should be avoided before bedtime (*because they tend to relax the muscles that protect airway permeability).*

If these measures fail, or if OSA is moderate to severe, other treatment options are available in the form of therapeutic devices or surgery.

The most effective treatments for sleep apnea are devices that deliver air at a slight pressure to maintain airway permeability. Several of these devices are available.

1. Continuous positive airflow pressure (CPAP) devices are used to treat moderate to severe OSA. As the name implies, a CPAP machine delivers continuous air pressure through a mask over the nose to overcome airway blockage to prevent apnea and snoring.
2. Expiratory positive airway pressure (EPAP) is the most recent device approved by the Food and Drug Administration (FDA). The valves on this device, one in each nostril, allow only partial expiration, keeping the airway open.
3. The Mandibular Advancement Device, MAD, is the most commonly used dental appliance for OSA. It keeps the airway open by pushing the mandible slightly forward and downward. MAD devices work in the same way as myofunctional therapy devices that correct retrognathia in growing children.

Several variations are available in orthodontic and dental laboratories. Examples of oral appliances for OSA and snoring include:

a. Sleep Herbst, Dorsal Fin, EMA, TAP, Slincer, SomnoDent, Klearway and the good old Bionator.
b. Another type of oral device TRD is designed to hold the tongue in place and keep the airway open by re-training the tongue,

Mandibular advancement devices (MADs) are oral appliances that reposition the jaw and tongue to keep the airway open during sleep. They can be effective in reducing snoring and improving sleep quality in patients with mild to moderate OSA. It is important to note that the use of oral appliances and MADs should be prescribed by a qualified dental or medical professional and tailored to the individual patient who prefer MAD or demonstrate adverse effects to CPAP therapy [4].

A long-term study conducted by Gauthier et al. [21] showed that they remain effective in reducing respiratory disturbance index (RDI) for up to 2.5 to 4.5 years. In addition, Gauthier et al. [22] also performed a cross-over randomized study showed that both *Silencer* and *Klearway oral appliances* reduced RDI and subjective daytime sleepiness in a similar way, but device comfort should also be considered to ensure compliance with treatment.

Mandibular advancement devices have been found to be effective in reducing the AHI (apnea-hypopnea index) in patients with mild to moderate OSA who are intolerant to CPAP devices. In the study by Vinzine et al. [23] they reported that 59% of the study subjects had a reduction in AHI to 14 with the use of mandibular advancement devices.

Follow-up with the orthodontist/sleep dentist is done at the 6 months point, at the 1-year point, and annually thereafter. During follow-up, the orthodontist/sleep dentist will evaluate, comfort, adherence, the structural integrity of the appliance, the efficacy of the appliance in controlling subjective symptoms, the presence of side effects, and the need for appliance adjustment or replacement [24].

Oral Appliances Side Effects

1. Subjective pain of the masticatory muscles and residual pain of the tongue but were considered clinically irrelevant by the authors.
2. Temporomandibular joint pain occurred in the initial phase, , long-term pain was low.
3. Excessive salivation,
4. Dry lips,
5. Dental discomfort

NB: *These side effects are minor compared to the benefits, but may cause the patient to stop using the appliance.*

Assessment of Cephalometric Before and After Treatment Showed

1. An increase in lower anterior facial height.
2. Dental changes consisted of rotation of the incisors and
3. A slightly open bite in the anterior and lateral regions.
4. Tooth mobility and tooth damage were rarely confirmed by physical examination.

Jaw Expansion

That's correct. Rapid maxillary expansion can help to correct narrow palatal arches and expand the nasal floor, leading to increased nasal airway resistance and reducing the risk of habitual mouth breathing. This can be beneficial for individuals with OSA, as narrowing of the nasal passages can contribute to the condition. By widening the palate and nasal floor, RPE can improve nasal airflow and potentially reduce symptoms of OSA.

Surgery

Surgical procedures are sometimes recommended as a second alternative or in combination with CPAP and oral appliances.

1. The procedures are successful in correcting bony structural abnormalities and permanently treating OSA.
2. Soft tissue procedures tend to relapse and lose respiratory mechanics receptors.
3. Surgical orthognathic orthodontics (Le Fort 1, sagittal mandibular advancement) is very effective in permanently increasing airway volume and therefore could be considered a "cure" for OSA.
4. Nasal surgery is successful in treating OSA when obstruction is due to deviated septum, enlarged turbinate's, or polyps.
5. Adenotonsillectomy is the treatment of choice in OSA children when enlarged adenoids and tonsils are the cause of airway obstruction. The procedure is without the side effect of loss of respiratory receptors and the resulting complications
6. Uvulopalato-pharyngoplasty (UPPP) involves partial removal of the soft tissues of the uvula, palate, and pharyngeal walls. It is performed with or without a laser. The long-term success rate of this procedure is less than 50%. Serious complications associated with this procedure include the following:

i. recurrence respiratory failure,
j. infection,
k. insufficiency of the laryngeal muscle protecting the airway from fluids,
l. difficulty swallowing,
m. vomiting of fluid,
n. excessive pharyngeal mucus,
o. voice changes,
p. pain, and worsening of the sense of smell.

7. Pillar palatal implant surgery is performed to reduce soft-palate vibrations that cause snoring.

Case Report

A male patient who is 60 years old visited the dental clinic to seek a second opinion regarding treatment options for his sleep apnea. He reported experiencing problems with snoring and frequently stopping breathing while sleeping, which prevents him from sleeping for even an hour without interruption. The patient had a history of consultation with an otorhinolaryngology's, who recommend surgical intervention, but the patient declined this line of treatment.

Clinical Examination

Extra Oral Examination

Patient had Brachycephalic pattern with straight profile with adequate lip seal.

Intra Oral Examination Revealed the Following

1. Molar and canine relation was class I.
2. Upper and lower incisors are proclined (Bimaxillary Protrusion).
3. Incisors were in edge to edge relationship. (Class III incisor relationship).
4. Large tongue covering the part of the occlusal table of the lower arch.

Modified Mallampati and Friedman Indices are

The Modified Mallampati index is a measure of the size of the upper airway. It is determined by examining the soft palate and uvula while the patient is in a seated position with their mouth open and tongue extended.

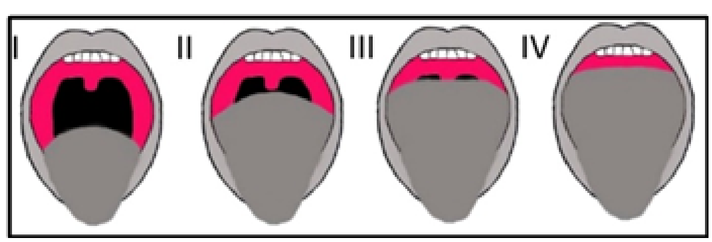


Figure 2: Modified Mallampati index.

The index ranges from I to IV, with class I am indicating a large airway and class IV indicating a small airway.

The Friedman tongue position and tonsil size grading system is another method of evaluating the upper airway. It considers the size of the tonsils and the position of the tongue. There are four grades of tonsil size (0-3) and three grades of tongue position (1-3). The higher the total score, the greater the risk of obstructive sleeps apnea.

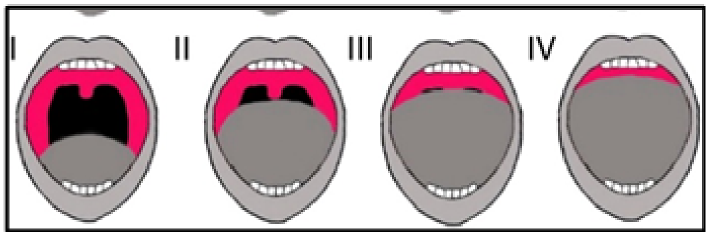


Figure 3: Friedman index.

The tongue volume was Class III, according to both the modified Mallampati and Friedman indices (Figure 2,3). Accordingly, the intra oral examination of the tongue exhibited grade (1V) indicating higher risk of obstructive sleep apnea.

Figure 4: Tongue volume Friedman and modified Mallampati scores indicate Class III tongue volume.

Figure 5: Intra oral photograph.

Figure 6: Intra oral view of the Modified Mono-Block Device in position for better control of lower incisor inclination, the lower incisors are covered with acrylic.

Figure 7: Front view with MMBD in position (a) and intra oral occlusal view (b).

Figure 8: Panto-mograph Lower right side: Teeth 46 and 47 RCT and crowned, 45 Implant replacement, 44 post and core + RCT. Lower left side: Implant replacement of 36, 37.

Appliance fabrication

To fabricate the appliance, an impression was taken of the upper and lower jaws with a bite registration. The mandible was advanced to the point where the lower incisors were in class III relationship with negative overjet while maintaining the midline. The impression and bite registration wax were then sent to the laboratory for appliance construction.

Appliance Insertion and Instructions

Once the modified MAD was ready, it was given to the patient with instructions on how to use it. The necessary adjustments were made to ensure a proper fit, and the patient was informed of potential side effects such as excessive salivation and speech difficulties. The patient was instructed to wear the appliance only at bedtime. The success of the treatment is expected within 2 to 3 weeks.

Figure 9: Cephalometric radiograph before insertion of Modified Mono-Block Device.

Figure 10: Cephalometric radiograph after insertion of Modified Mono-Block Device.

The patient was presented with different treatment options, and he ultimately preferred to begin treatment with a specific type of intraoral mandibular advancement device (MAD), specifically the Modified Mono-Block Device. This device is commonly used to treat obstructive sleep apnea and snoring by repositioning the jaw to keep the airway open during sleep. It's important for the patient to follow the instructions provided by their healthcare provider and attend any follow-up appointments to ensure the device is working effectively and to address any concerns or issues that may arise.

Figure 11: The upper view of the Device with Ball clasps and C- Clasps on upper right and left first molars to hold the MMBA. Retention was enforced with two Ball Clasps between upper right and left first and second premolars in both sides.

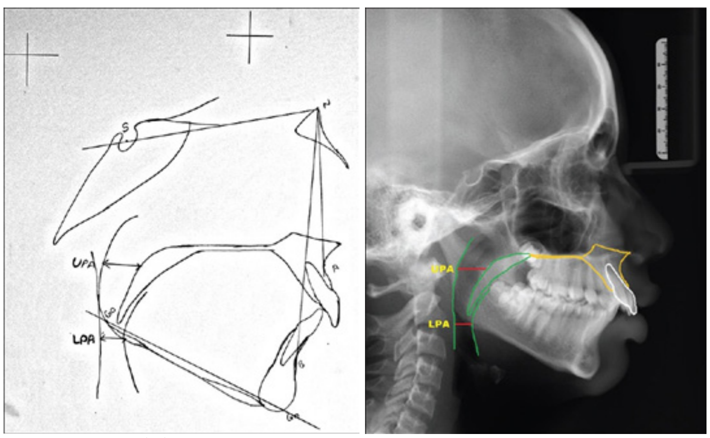
After taking off the sleep appliance in the morning, the patient wears the morning appliance for a short time. The purpose of the morning appliance is to reposition the mandible into its habitual pre-oral advancement therapy (OAT) position and to reverse changes that may have occurred in tooth position [24]**.** However, in our case, this morning appliance was not included. It's important for the patient to follow through with the recommended course of treatment to improve their quality of sleep and reduce the risk of associated health problems.

Figure 12: View of the lower occlusal capping of lower incisors (Refer to Fig 3 and 4).

Treatment result

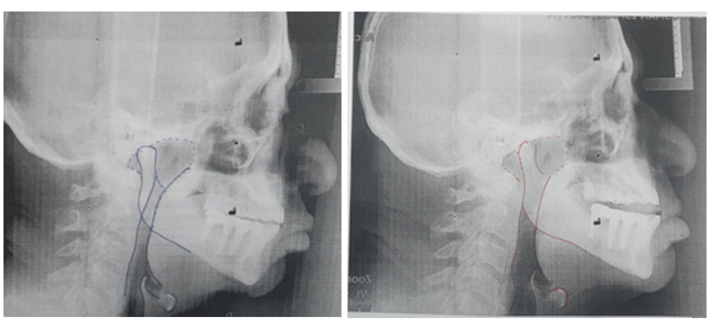
After utilizing the MMBA device for a period of three months, the patient expressed a high level of satisfaction with its performance. He was delighted to report that he was able to sleep for extended periods without experiencing any breathing cessation episodes, and he no longer suffered from frequent sinusitis, a condition he had previously experienced. The patient acknowledged becoming reliant on the appliance and noted a marked improvement in his overall quality of life. In fact, he requested an additional MMBA device as a contingency plan in case of loss or damage, a request that was promptly granted.

McNamara airway analysis was used to measure the upper pharyngeal airway (UPA) and Lower pharyngeal airway (LPA) {Figures 8. (A, B)} Upper pharyngeal width was measured from a point on the posterior outline of the soft palate to the closest point on the posterior pharyngeal wall. Lower pharyngeal width was measured from the intersection of the posterior border of the tongue and inferior border of mandible to closest point on the posterior pharyngeal wall.



(A) (B)

Figure 13: A, B. Cephalometric radiograph indicating the upper pharyngeal airway and lower pharyngeal dimensions for measuring the pharyngeal dimensions according to McNamara. (Prabhakaran Mani. J Pharm Bioallied Sci.2015).



(A) (B)

Figure 14: Cephalographs before (A) and after (B) the insertion of the Modified Mono-Block Device (indicating the widening of the upper airway space when using MMBA (B).

Discussion

Many doctors and dentists are not aware of the potential contribution orthodontics; in particular, can play a major role in the multidisciplinary treatment of obstructive sleep apnea. Because of this, the purpose of this article is to offer a thorough explanation of obstructive sleep apnea syndrome, its related problems, available treatment options, and the role of orthodontics and general dentistry in managing this illness. This was supported by presenting a case report managed with new modified Monoblock mandibular advancement device. This could entail a multidisciplinary strategy, combining the knowledge of dental and medical experts to create a thorough treatment plan that covers every facet of the patient's condition.

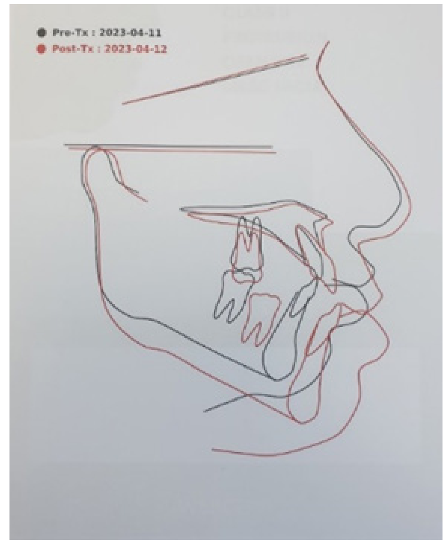


Figure 15: Superimposition of both cephalographs without appliance insertion (black line) and after insertion of the MMBA device (red line), indicating advancement of the mandible in downward and forward direction.

Diagnosis of OSA should be done by specialized sleep physicians. Physicians decide whether to send the patient for an overnight in-lab sleep test called polysomnography (PSG) or an overnight home sleep apnea test (HSAT) [18,20]. It's good that the patient in this case report has sought a second opinion, as OSA can have serious health consequences if left untreated, including increased risk of cardiovascular disease, high blood pressure, stroke. As well as diabetes which this patient had.

The first step to take is to investigate whether the underlying cause of the condition can be controlled or managed using conventional methods like behavioral modifications. If this approach is not feasible, the next option is to explore the use of intra-oral devices or continuous positive airway pressure (CPAP). Surgery should only be considered as a last resort after all other alternatives have been attempted. Therefore, for moderate to severe cases of sleep apnea, clinicians must carefully evaluate each patient's individual situation and determine the most appropriate treatment approach based on their specific needs and circumstances. The ultimate goal of treating OSA is to ensure that the individual can breathe properly and receive adequate oxygen during sleep. This can be achieved through various treatment approaches, including raising the pressure of the pharynx above obstructive pressure, reducing obstruction, and increasing upper airway muscle activity to widen the pharyngeal airway [21,22].

The Board of Directors of the American Academy of Dental Sleep Medicine (AADSM) brought together leaders in the profession to develop the definition of an effective oral appliance for the treatment of sleep disordered breathing based on current research and clinical experience [25]. Oral sleep appliances have been utilized in various forms, with the mandibular advancement device being one of them. According to Kurtulmus et al. [26] the Mandibular Advancement Splint (MAS) activated the masseter and submental muscles to maintain the upper airway open during sleeping. They stated that this prosthetic appliance was helpful in the treatment of both mild and moderate OSA conditions and is considered the most effective method for oral appliance therapy.

According to Almeida et al. [27] oral appliances should be considered as the primary treatment option for mild to moderate obstructive sleep apnea-hypopnea syndrome (OSAHS), as they have shown a high degree of effectiveness in improving the condition and have resulted in high levels of patient satisfaction. According to studies conducted by Chaves et al. [28] and Engelke et al. [29] behavioral management is a viable treatment approach for patients with mild OSA. However, for those with moderate to severe OSA, continuous positive airway pressure (CPAP) is often deemed the most effective treatment option, as reported by research studies [30,31].

Additionally, orthognathic surgery has been recognized as a potential solution for reducing the Apnea-Hypopnea Index (AHI) to normal levels, as confirmed by studies conducted by Ito et al. [32] and Prado et al. [33] For patients with primary snoring and mild to moderate sleep apnea, as well as those with severe apnea who are not able to undergo surgery or do not tolerate CPAP, intraoral devices may be recommended [34]. However, comparative studies conducted by Poluha et al. [35] and Almeida et al. [27] have reported that the use of mandibular advancement devices (MADs) can result in side effects such as mandibular protrusion, maxillary retrusion, and temporomandibular disorders (TMD), which can cause significant discomfort for patient. However, this can be avoided by advising the patient to wear the morning appliance for a short time to reposition the mandible into its habitual position before using the oral appliance and to reverse changes that may have occurred in tooth position [25]. In this case, our patient did not complain from the above-mentioned side effects with our new Modified Mono-block device.

From the information presented, it appears that the 60-year-old male is exhibiting symptoms consistent with obstructive sleep apnea (OSA). Despite previous negative experiences with CPAP and refusal of surgical intervention, the patient found success with the new Modified Mono-Block Device (MMBD). This device can be used in conjunction with other appliances, including fixed orthodontic appliances, without interference. The patient expresses satisfaction with the new MMBD and has requested a backup in the event of loss or damage. These findings suggest that the new MMBA device is a valuable device for managing patients suffering from moderate to severe cases of obstructive sleep apnea. Additional advantages it can be used as mandibular functional appliance in orthodontic treatment of patient having Class II div 1 or div 2 malocclusion with retruded mandible associated with increased deep bite. Moreover, the appliance can be used in patients with tongue thrusting as well as in thumb sucking habits. Thus, indicating that MMBD can be considered as a multidisciplinary appliance.

It is noteworthy to keep in mind that the significant role that the tongue plays in causing obstructive sleeps apnea. The tongue, genioglossus muscle, and suprahyoid muscles are all critical in maintaining an open airway during sleep, and any obstruction can result in obstructive sleep apnea (OSA). Therefore, it is important to recognize the role of the tongue in OSA management and consider medical intervention when necessary to prevent further health complications. The mode of action of the MMBD appliance is to prevent closing the pharyngeal airway by providing continuous mandibular advancement and holding the tongue in an anterior position. In this case, the MMBD also produced a long-term improvement in the positions of the bones and tongue. It increased the intermaxillary space in which the tongue rests, brought the tongue upward and forward, and brought the hyoid bone downward and forward. This has been noted in various studies [1,36,37].

A systematic review by Ruoff and Guilleminault concluded that a combination of pharyngoplasty with adenotonsillectomy, nasal septum repair, and mandibular-maxillary advancement surgery may provide the best outcomes for treating OSA. Bi-bloc mandibular advancement devices (MADs) alone or in combination with soft-tissue surgery may also be effective with fewer risks and complications. Collaboration between otolaryngologists and orthodontists is crucial, and specialized training programs in maxilla-mandibular advancement surgery for OSA treatment are needed [38].

In order to reduce the likelihood of negative effects related to intraoral devices used to manage obstructive sleep apnea (OSA), it is important to carefully select patients, design appliances appropriately, and provide appropriate follow-up care. Patients should also be advised to wear the device as directed and promptly report any discomfort or adverse effects to their dentist or physician. Regular monitoring and adjustment of the device may be necessary to maintain its effectiveness and minimize the risk of side effects. It is noteworthy that in this case report, the patient did not report any dislodgement of the device during sleep, nor did require any adjustments during follow-up visits.

Study conducted by Erwin Rojaset at al. concluded that understanding upper airway assessment techniques is crucial in identifying potential functional changes that may impact treatment outcomes. A comprehensive approach should involve a clinical examination, radiographic evaluation, and CBCT to gain a better understanding of the upper airway [39]. Further, very recently Liu et al. [40] conducted study aimed to establish a simple and accessible method for rapid screening of mixed-OSA, thus promoting OSA precise diagnosis. They stated" Our research found that AHI > 47 or LSO2 < 77% are independently associated with mixed-OSA and can be used to quickly identify the occurrence of mixed-OSA. Therefore, this study can help detect mixed-OSA and precise individual diagnosis of OSA patients" Furthermore, Ciavarella et al. [41] introduced a new fully customizable MAD-type device called, "It Makes You Sleep" (IMYS), in patients with mild to moderate OSA and concluded that the IMYS appliance is an effective device for treating mild or moderate OSA.

A comprehensive and multidisciplinary approach is essential for managing obstructive sleep apnea (OSA) effectively. The sleep team, which includes the sleep physician or dentist as well as the orthodontist, should not be discouraged by the trial and error process that often accompanies OSA management. Through collaboration and the use of diverse treatments like behavioral modifications, oral appliances, CPAP, and surgery, the sleep team can tailor a treatment plan that meets the unique needs of each patient [42]. Finally, the development of new treatment options like the Modified Mandibular Advancement Device for OSA emphasizes the importance of continued innovation in the field. This device has shown promising results in managing OSA, as demonstrated in the case report. While more research is necessary to establish its effectiveness and any potential negative consequences in a larger patient population, clinicians should consider using it in suitable cases. The review underscores the significance of upper airway assessment in orthodontics and stresses the importance of practitioners staying up to date with the latest assessment methods for better treatment outcomes. However, early diagnosis, comprehensive understanding of OSA, and effective management remain vital for enhancing patient adherence to treatment, improving sleep quality, and reducing associated health risks, leading to a better overall health and improved quality of life.

Conclusions

Obstructive sleep apnea (OSA) and snoring are common conditions that can have significant impacts on individuals and society. In this article, we present a new developed device used in treatment of OSA and presented the current research on OSA, snoring management, the role of the orthodontist in treatment and the importance of interdisciplinary collaboration. Here is the summary of some of the main points:

1. Obstructive sleep apnea and snoring have significant impacts on individuals and society.
2. Research shows that management with fixed orthodontics and/or intraoral appliances are effective in treating OSA and snoring.
3. Dentists and orthodontists are in a good position to prevent, diagnose, and treat these common medical conditions but need to realize their potential.
4. Collaboration with the medical sleep community can benefit OSA patients.
5. The appropriate treatment for obstructive sleep apnea depends on the severity of the condition and individual patient needs.
6. Treatment options include devices such CPAP. MADs as well as the new Modified Mono-Block Device (MMBA) presented in this article to keep the airway open and reposition the lower jaw, and lastly surgery in some cases.
7. Seek medical advice if experiencing symptoms or if snoring is loud and interrupted by silence.
8. Dentistry plays a crucial role in interdisciplinary OSA treatment.
9. It's essential to consult a doctor as excessive daytime drowsiness may be indicative of other disorders such as narcolepsy.

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