

# Obstructive Sleep Apnea And Its Management: A Literature Review

Dr. Faiz Ansari<sup>1</sup>, Dr. Shweta Chaudhary<sup>2</sup>, Dr. Chetana Jagtap<sup>3</sup>, Dr. Alok Patel<sup>4</sup>,  
Dr. Preetam Shah<sup>5</sup>, Dr. Sanket S. Kunte<sup>6</sup>

<sup>1</sup>Post-graduate student, Bharati Vidyapeeth Dental College and Hospital, Pune, India(Corresponding author)

<sup>2</sup>Associate Professor, Bharati Vidyapeeth Dental College and Hospital, Pune, India

<sup>3</sup>Assistant Professor, Bharati Vidyapeeth Dental College and Hospital, Pune, India

<sup>4</sup>Head of Department, Bharati Vidyapeeth Dental College and Hospital, Pune, India

<sup>5</sup>Professor, Bharati Vidyapeeth Dental College and Hospital, Pune, India

<sup>6</sup>Professor, Bharati Vidyapeeth Dental College and Hospital, Pune, India

## Abstract:

**Obstructive sleep apnea (OSA)** is a disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts the normal ventilation during sleep and normal sleep patterns. It is a common condition in childhood and can result in significant health complications if left untreated.

Early diagnosis of OSA has the potential to decrease morbidity and increase the quality of life, but diagnosis is frequently delayed. Thorough clinical and oral examination can show signs and symptoms of existing OSA. While the gold standard test to diagnose OSA is overnight, attended, in-laboratory polysomnography (PSG), there are more conservative ways such as questionnaires to diagnose the indications of this disorder.

Treatment for OSA requires long-term and multidisciplinary management and Continuous positive airway pressure therapy (CPAP) is often the first approach of management mainly in adults. Mild severity cases showing no improvement by CPAP therapy can also be managed using several oral appliances with different principles of action. Aim of this review is to study the clinical aspects of sleep apnea, its affect on dental and general health and alternative techniques of managing the OSA with oral appliances and recent technologies.

**Keywords-** Sleep Apnea, Obstructive, Oral Appliances, Airway Management

## Introduction:

**Obstructive sleep apnea (OSA)** is a common condition in childhood and can result in significant health complications if left untreated. Obstructive Sleep Apnea Syndrome has been defined as a “disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts the normal ventilation during sleep and normal sleep patterns.” -AAPD.<sup>1</sup>

Early diagnosis of OSA has the potential to decrease morbidity and increase the quality of life, but diagnosis is frequently delayed. As pediatric dentists, we are in a unique position to help identify patients at greatest risk.

The gold standard test to diagnose OSA is overnight, attended, in-laboratory polysomnography (PSG).<sup>2</sup> The apnea-hypopnea index (AHI) is the most commonly used PSG parameter to quantify OSA severity.<sup>3</sup>

**Treatment for OSA** requires long-term and multidisciplinary management.<sup>2</sup>

The aim of this review is to study the etiological, clinical aspects of sleep apnea in children and how it affects the dental and general health. Followed with the diagnosis and the types of treatment approach for the same.

## Causes and risk factors:

### Causes of sleep-related breathing disorders in children with respect to age<sup>4</sup>

#### 1. Neonates and infants

- Nasal aplasia
- Stenosis
- Atresia Nasal or nasopharyngeal masses
- Craniofacial anomalies – Presented as hypoplasia of mandible and maxilla
- Macroglossia (Beckwith-Wiedemann)
- Vascular malformations of tongue and pharynx
- Congenital cysts of the vallecula
- Tongue Neuromuscular disorders

#### 2. Toddlers and older children

- Rhinitis, nasal polyposis,
- Septal deviation causing narrowing of nasopharynx (Hunter's, Hurler's, Down's, achondroplasia)
- Adenotonsillar hyperplasia Obesity
- Macroglossia (Down's)
- Vascular malformations of tongue and pharynx
- Neuromuscular disorders

## Signs and symptoms:

Snoring is likely to be the most common sign of sleep apnea when it is followed by silent breathing pauses and choking or gasping sounds<sup>28</sup>.

### Common symptoms during sleep

- Snoring, usually loud.
- Gasping or choking sounds.
- Breathing pauses observed by someone watching sleep.
- Sudden or jerky body movements.
- Restless tossing and turning.
- Frequent awakenings from sleep

### Common symptoms while awake

- Wake up feeling like sleep was not enough, even after sleeping for many hours.
- Morning headache.
- Dry or sore throat in the morning from breathing through the mouth during sleep.
- Sleepiness during the day.
- Fatigue or tiredness through the day.
- Personality changes, irritation
- Problems with poor memory or inability to concentrate.<sup>5</sup>

ADULTS	CHILDREN
Heavy persistent snoring	Snoring
Excessive daytime sleepiness	Restless sleep
Apneas as observed by bed partner	Sleepiness
Choking sensations while waking up	Hyperactivity
Gastroesophageal reflux	Aggression and Behavioral disturbance
Reduced ability to concentrate	Frequent colds or coughing
Memory loss	Odd sleeping positions
Personality changes	
Mood swings	
Night sweating	
Nocturia	

<p>Dry mouth in morning'</p> <p>Restless sleep</p> <p>Morning headache</p> <p>Impotence</p>	
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### Symptoms of sleep apnea in adults and children<sup>6</sup>

#### Signs of sleep apnea<sup>7</sup>

##### Craniofacial

- Retrognathia
- High arched palate
- Temporomandibular dislocation

##### Pharyngeal

- Macroglossia
- Erythema/edema of uvula
- Elongated, low lying soft palate
- Tonsillar hypertrophy
- Retropalatal, retroglossal space restriction

##### Dental

- Overjet
- Malocclusion
- Bruxism
- Orthodontia

##### Nasal

- Asymmetric small nares
- Collapse of alae and internal valves while inspiration
- Septal deviation
- Inferior turbinate hypertrophy

#### Diagnosis

Clinical signs and symptoms detected during a thorough sleep evaluation, which includes a sleep-oriented history and physical examination, as well as results from sleep testing, serve as the basis for the diagnostic criteria for OSA.<sup>8</sup>

### History and physical examination

- Recording the sleep history is the initial step in the diagnosis of sleep apnea.
- Questions to ask during a regular health maintenance examination should focus on a history of snoring and daytime sleepiness as well as an assessment for the presence of obesity, retrognathia, or hypertension.
- In a patient who is suspected of having OSA, a thorough sleep history should include a check for snoring, witnessed apneas, gasping or choking episodes, excessive sleepiness not explained by other factors, including an assessment of sleepiness severity using the Epworth Sleepiness Scale, total amount of sleep, nocturia, morning headaches, sleep fragmentation/sleep maintenance insomnia, and decreased concentration and memory.<sup>9</sup>

#### Oral examination

- The likelihood of upper airway collapse depends upon a number of factors, including the shape and size of the upper airway. Obesity or a small maxilla or mandible might cause a smaller airway to collapse more easily than a larger airway.
- Patients with OSA have higher volumes of soft tissue structures (larger tongues) as seen in imaging examinations of the upper airway. A limited upper airway caused by skeletal and/or soft tissue anomalies frequently affects OSA patients. An evaluation of the size of the tongue, the presence and size of the tonsils, the opening of the oral and nasal airways, and the size of the neck can raise concerns on the patency of the airway.
- Bruxism could occur before, after or unrelated to breathing event. Due to the fact that bruxism raises muscle tone and may dilate the airway, a considerable portion of people with the condition may also have OSA.<sup>9</sup>

**Objective testing**

- No clinical model is recommended to predict severity of OSA, therefore objective testing is required.
- **The two approved procedures for objective testing are home testing with portable monitors (PM) and in-lab polysomnography (PSG).**

**Polysomnography**

- Electroencephalogram (EEG), electrooculogram (EOG), chin electromyogram, airflow, oxygen saturation, respiratory effort, and electrocardiogram (ECG) or heart rate must all be recorded during polysomnography (PSG) in order to assess OSA. Body position and leg EMG derivations are additional recommended criteria.<sup>7</sup>

**Testing With Portable Monitors**

Portable Monitors should only be used in conjunction with a thorough sleep examination to diagnose OSA.

**Subjective Tests Of Sleepiness can be determined by**

- The Epworth Sleepiness Scale (ESS)
- Berlin questionnaire
- STOP BANG questionnaire
- Stanford Sleepiness Scale (SSS)<sup>10</sup>

**IMAGING is a probable tool of diagnosing the obstruction or deviations<sup>6,11</sup>**

- Somnofluoroscopy with video recording
- Computed tomography

- Cephalometry
- MRI

**Patient education**

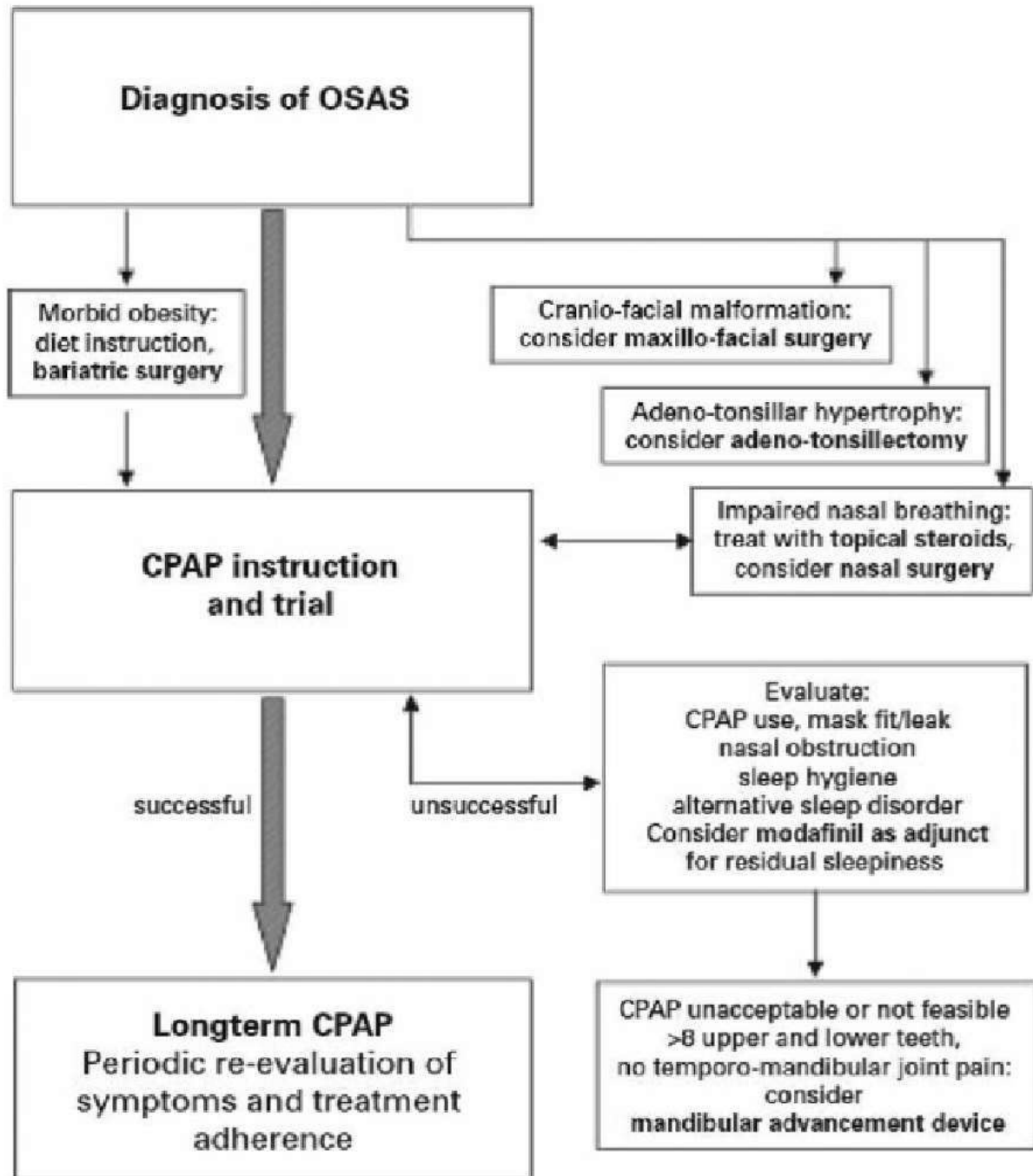
- The curriculum ought to cover the pathophysiology, risk factors, natural history, and clinical effects of OSA.
- Treatment opinions should be discussed in the context of the severity of the patients OSA, their risk factors, any associated conditions, and the patient's expectations.
- There should be general education on the effects of medicine, risk factor reduction, alcohol avoidance, proper sleep posture, and weight loss.
- A multidisciplinary chronic disease management team, comprising the sleep physician, the referring provider, and an allied health care professional, should give patient education in the best possible way.<sup>12</sup>

**Management**

The upper airway collapsibility that results from the multifactorial aetiology of OSA is brought on by a complicated interplay between anatomical and neuromuscular variables.<sup>12</sup>

**Positive airway pressure therapy —**

First described by Sullivan in 1981, Positive airway pressure therapy is the mainstay of therapy for adults with OSA. In order for the intraluminal pressure to be greater than the ambient pressure, the mechanism of **continuous positive airway pressure (CPAP)** relies on maintaining a positive pharyngeal transmural pressure. CPAP also stabilises the upper airway by increasing end-expiratory lung capacity. Thus, respiratory episodes brought on by upper airway collapse, such as apneas and hypopneas, are avoided.<sup>13</sup>



#### Treatment options for obstructive sleep apnea (Bloch 2006)<sup>14</sup>

##### Management using oral appliances

**Oral appliances** — An oral appliance is a viable alternative to positive airway pressure therapy for patients with mild or moderate OSA who reject it or fail to use it as prescribed.

There are an increasing number of oral appliances that are designed to either protrude the mandible forward or hold the tongue in a more anterior

position. Either design holds the soft tissues of the oropharynx away from the posterior pharyngeal wall, thereby maintaining upper airway patency.<sup>15</sup>

An individual patient's oral anatomy are reproduced in digital or physical models and impressions to create a personalised oral appliance. As a result, it is not a prefabricated item that is generally modified by trimming, bending, relining, or other means. It engages both the maxillary and mandibular arches and is comprised of

biocompatible materials. Non-custom oral appliances, also referred to as "boil and bite devices," are mostly prefabricated and typically only slightly customised to each patient's unique oral features. It is necessary to distinguish between oral appliances and tongue retaining devices (TRDs), which are both custom- and non-made oral appliances that hold the tongue forward. The effectiveness of TRDs for treating adult OSA patients could not be determined due to a lack of solid evidence.

Oral appliances are either titratable or not titratable in addition to being either custom-made or not. A mechanism in titratable oral appliances permits different levels of mandibular protrusion. The titration of continuous positive airway pressure (CPAP) is thought to be comparable to the growing protrusion of the jaw. Non-titratable oral appliances keep the mandible in a single protrusive position, and treatment-related modifications are not conceivable.

The American Academy of Dental Sleep Medicine (AADSM) published a definition of an *effective* oral appliance in March 2013, focusing on custom-titratable oral appliances.<sup>16</sup>

#### Mechanism of action of oral appliances

The presumed mechanism of action for oral appliances is that anatomical changes in the oropharynx, produced by MAA, result in an alteration of the intricate relationships between different muscle groups controlling the upper airway calibre.

**Soft Palate Lifting:** To prevent the soft palate from vibrating as one sleeps, the prosthesis lifts and/or stabilises it. This device can be employed in situations when snoring is brought on by the soft

palate's incapacity. Due to the appliance's contact with the soft palate and uvula, the soft palate raising appliances have a limited range of application in patients who have an overactive gag reflex. Because of patient tolerance and the belief that tongue posture rather than soft palate position has a substantial impact on the patency of the upper airway, the soft palate raising device is not frequently employed.<sup>17</sup>

**Uvula Lift Appliance:** A stainless steel stock tray is extended posteriorly and filled with extra-hard base plate wax to create an irreversible hydrocolloid impression of the maxillary arch that extends up to the uvula. This device can be utilised in situations when an extended or bifid uvula blocked the upper airway.

**Tongue Retention:** Tongue Retaining Devices (TRDs) create negative pressure vacuum when the tongue is inserted in the anterior hollow bulb of the device. The tongue is held forward away from the posterior pharyngeal wall opening up the airway and simultaneously modifies the position of the mandible.

TRD consists of a mouthpiece that covers the entire upper and lower dental arches with a defined mandibular protrusion. Due to the negative pressure caused by the displacement of air from the device's lingual chamber, it pulls the tongue slightly forward. The TRD is the most suitable appliance in edentulous patients.<sup>18</sup>

**Mandible Repositioning Appliances:** It hold the mandible in an antero-inferior position, which indirectly brings the tongue forward opening up the posterior airway. The soft palate's attachment to the base of the tongue allows for stretching, which reduces the soft palate's collapsibility and expands the superior airway space.

Sr. no.	Product name	Company	Indication	Type	Mechanics	Material
1	Herbst appliance <sup>19</sup>	Bronsky Orthodontics, Great Lakes Orthodontics Ltd etc.	severe OSA	Non-custom Boil and Bite	Shifting the mandible into a more protrusive posture and retaining it there, keeping the tongue out and the airway open.	Standard hard acrylic and soft version

2	<b>TAP3 Elite<sup>20</sup></b>	Accutech, Orthodontic Lab Inc.	Severe OSA  Bruxism	Non- custom  Boil and Bite	The jaw moves forward and is stabilised, preventing the tongue and throat tissues from pressing against the airway.	Surgical grade stainless steel hardware+triple laminate or ThermAcryl
3	<b>MPowRx Snoring and Sleep Apnea Appliance<sup>21</sup></b>	Great Lakes Orthodontics Ltd	severe OSA  Bruxism	Custom Boil and Bite	Positions the tongue forward rather than  relying on the dentition or alveolar ridge to maintain  its position. No impression needed.	Elastomer
4	<b>MicrO<sub>2</sub> Sleep Device<sup>22</sup></b>	microDental Laboratories	severe OSA  Bruxism	Non- custom  Boil and Bite	Utilizes vertically mated buccal posts to advance and hold the mandible forward to  open the airway.	Pre-polymerized, milled poly-methyl methacrylate (PMMA).
5	<b>Oravan<sup>23</sup></b>	OravanOSA	Severe OSA  Bruxism	Non- custom  Bite	Opens the patient's airway through advancement of the mandible and holding the jaw in a forward position. The true open  anterior design of the device encourages  natural protrusion of the tongue and  maximum patient comfort	<b>Acrylic</b>
6	<b>SomnoDentFusion<sup>24</sup></b>	SomnoMed Inc	Severe OSA  Bruxism  Snoring	Non- custom  Boil and Bite	The mandible moves forward to widen the airway and keep the jaw in place.	<b>Acrylic</b>
7	<b>Somnowell Chrome<sup>25</sup></b>	Somnowell Inc	Severe OSA  Bruxism	Non- custom	Makes use of a telescopic Herbst	Chrome cobalt and stainless steel.

			Snoring	Boil and Bite	system that is telescopically adjustable to hold the jaw forward and not lateral displaced.  Anchorage is provided by the chrome-cobalt framework.	
8	SomnoGuard AP 2 <sup>26</sup>	Dr. Toussaint GmbH	Severe OSA Bruxism	Custom Noncustom	The 2-part SomnoGuard AP repositions the lower jaw forward and thereby prevents the collapse of the upper airway. With the device in place, the upper airway is wider and the patient can breathe more easily without snoring	Rigid tray walls: rigid polycarbonate; lining: soft thermal copolymer; stainless steel adjusting screws.

### Limitations of oral appliances

Changes in the dentition have been reported to occur with functional bite jumping appliances. In general, proclination of lower incisors and retroclination of upper incisors occur because the pressure on the mandibular teeth is directed forward and the maxillary pressures are directed backward when the patient is using the appliance.<sup>27</sup>

Pancer et al reported side effects such as excessive salivation (30%), xerostomia (23%), temporomandibular joint pain (26%), myofascial pain (25%), and occlusal changes (16%), but these side effects were mostly minor and temporary.<sup>28</sup>

### Surgical procedures

When the discussed approaches do not show correction of sleep apnea, depending upon the severity, the anatomy (obstruction) and morbidity conditions a surgical approach is indicated.<sup>29</sup>

### Various surgical procedures to treat OSA are:

Tracheotomy

Uvulopalatopharyngoplasty (UPPP)

### Recent advances

#### Pacemakers in sleep apnea

Some of the most recent sleep apnea treatments include pacemakers. An effective treatment for persons with moderate to severe obstructive sleep apnea, according to a recent study, is to pace the hypoglossal nerve in the neck as they sleep. The average amount of breathing obstruction incidents decreased by almost 50% a year following pacemaker implantation. In addition, night-time oxygen levels improved, as did measures of quality of life and daytime sleepiness.

#### Hypoglossal pacemaker

- The pacemaker has three major components – 1) A stimulation electrode is surgically installed on one of the two hypoglossal nerves, which make up the pacemaker. 2) a sensor electrode that is surgically implanted in the chest and recognises the beginning of inhalation. The electrical generator serves as the pacemaker's third source of electricity. The



hypoglossal nerve, which is the main nerve to the tongue, is signalled to activate when the detecting electrode detects the beginning of a breath. As a result, the tongue muscle becomes more rigid and resists the airway closing, preventing apnea.

- Two reasons have hindered widespread use—cost and lack of data showing effectiveness in patients who are severely obese. The insertion procedure is not complicated, although it requires a brief surgical procedure and follow-up to adjust the pacemaker settings.<sup>30</sup>

### **Auto adjusting mandibular repositioning device for in- home use**

The endorsement of MADs as a therapy for OSA by the medical profession has been hindered by the repeated adjustments that are required before the maximum efficacy of treatment is achieved and/or confirmed, and also by the lack of objective means to assess patients' nightly use of MADs.<sup>31</sup>

### **3b medical**

Rio from 3B Medical is incredibly light, adaptable, and simple to use. It has a ball-in swivel socket, a one-step cushion replacement process, and it weighs 1.5 oz.<sup>32</sup>

### **Advanced brain monitoring (ABM)**

Advanced Brain Monitoring's (ABM) Positional Sleep Assessment Software combines data from ABM's Night Shift and Nonin's WristOx to give screening for positional OSA and snoring and/or evaluate the effectiveness of treatment.<sup>33</sup>

### **Circadiance**

Circadiance's SleepWeaver Advance Pediatric is a soft cloth PAP mask approved for use in 2- to 7-year-olds and can also be used in non-invasive ventilation applications with select systems.<sup>34</sup>

### **Drive devilbiss**

The PulseDose Humidification system, PureView AutoAdjust Algorithm, and award-winning SmartLink App allow the Drive DeVilbiss IntelliPAP 2 CPAP System to provide the highest level of comfort, performance, and patient therapy monitoring.<sup>35</sup>

### **F&P- nasal mask**

With the F&P Eson 2, a nasal mask created to fulfil the demands of patients and healthcare professionals at each significant stage of the CPAP therapy.<sup>36</sup>

### **Watch pat**

Itamar Medical received FDA clearance to expand the medical indication of WatchPAT for sleep apnea diagnosis from the age of 12, expanding the previous indication for ages 17 and older.<sup>37</sup>

### **Luco hybrid OSA**

The FDA has approved the Luco Hybrid OSA Appliance (K160477) as a sleep bruxism treatment and to help manage adults' related tension/migraine headaches.<sup>38</sup>

### **Sphinx pmu710**

The most recent amplifier to join the Nihon Kohden family is the Sphinx PMU710. Designed to meet the AASM's polysomnography recommendations, the IP addressable Sphinx incorporates features such as built-in SpO<sub>2</sub>, pressure transducer, intercom/microphone, and 6 to 14 DC inputs.<sup>39</sup>

### **Oravanosa**

A totally open anterior design, which encourages natural tongue protrusion, optimum patient comfort, and minimal interference with anterior aesthetic surgery, is a feature of OravanOSA's Medicare-approved Oravan Herbst for OSA.<sup>23</sup>

### **O2vent t**

This 3-D printed titanium oral appliance is intended to reduce or alleviate snoring and mild to moderate obstructive sleep apnea.<sup>40</sup>

### **Respironics - nasal mask**

Supporting non-invasive ventilation, **Philips Respironics'** Wisp Pediatric Nasal Mask features a giraffe fabric pattern, a modified cushion curvature, and support tools to help provide a positive experience for young patients.<sup>41</sup>

### Astral ivaps

By continuously comparing the patient's actual ventilation and respiratory rate to the target rates and automatically modifying pressure support as necessary, Astral IVAPS by ResMed intelligently adjusts to the patient's changing needs.<sup>42</sup>

### Sommetrics cnep

FDA For treatments involving light to moderate sedation, the FDA has approved Sommetrics' cNEP

Airway System as a "External Airway" noninvasive device to help avoid sedation-related apneas.<sup>43</sup>

### Whole you

**Whole You Sleep Appliance** Respire Blue Endurance Framework (EF) for obstructive sleep apnea increases tongue room for improved wearing comfort, especially for patients with larger tongues.<sup>44</sup>



1- Soft palate lifting appliance<sup>17</sup>, 2- Tongue retaining device<sup>18</sup>, 3- Herbst appliance<sup>19</sup>, 4- TAP3 Elite<sup>20</sup>, 5- mPowrx Snoring & sleep apnea appliance<sup>21</sup>, 6- MicroO2 sleep device<sup>22</sup>, 7-Oravan<sup>23</sup>, 8- Somnodent fusion<sup>24</sup>, 9- Somnowell chrome<sup>25</sup>, 10- Somnoguard AP 2<sup>26</sup>, 11- Rio (3B medical)<sup>32</sup>, 12- Luco Hybrid OSA Appliance<sup>38</sup>, 13- Astral Ivaps<sup>42</sup>, 14- O2Vent T<sup>40</sup>, 15- Whole You Sleep Appliance Respire Blue Endurance Framework(EF)<sup>44</sup>

## Conclusion

In the early diagnosis, treatment, and care of individuals with sleep apnea, our work as dental practitioners is crucial. Oral appliances are now almost universally used as the first line of treatment for OSA patients and serve a significant role in its non-surgical management. We should therefore become familiar with this therapeutic approach. Mandibular advancement devices can be offered as a viable alternative to patients with mild to moderate OSA, intolerant to CPAP. The role of surgery remains controversial.. Dentists must receive advanced training in the oro-facial complex that may benefit the field and should seriously consider investing time in expanding their knowledge in dental sleep medicine.

## Conflict of interest:

There are no conflicts of interest

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