Types of Oral Appliances for the Treatment of Snoring and OSA

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Snoring and/or sleep apnea affects 3 million Australians. A CPAP device is the gold standard for treating this condition. CPAP stands for continuous positive airway pressure and this is facilitated by a machine that increases air pressure in the throat. The air is forced through with a mask that covers the nose, the nose and mouth or prongs that fit into the nose.

Increasingly, patients often do not find success with this device for a variety of reasons, and for some this results in a really diminished quality of life.

For those patients, alternatives such as dental appliances and surgery are available, but deter- mining which option is ideal can be taxing on patients, often causing them to see a variety of specialists separately.

The ideal solution should be a multi-disciplinary clinic with a number of health care providers con- sulting the patient simultaneously. These clinicians would include a sleep medicine specialist, a den- tist, a maxillofacial surgeon and an ear, nose and throat doctor. "This approach is mainly for cases that cannot tolerate standard treatment, which is CPAP," says Dr Alp Baran, a sleep medicine specialist, psychiatrist and director of The Sleep Disorders Center at the University of Mississippi Medical Center.

Not being able to tolerate treatment can be a combination of the discomfort of using the CPAP unit; that it disturbs your bed partner; or that it is inconvenient to transport if you travel often. As a result of untreated OSA, some patients battle depres- sion and decreased libido, lose their jobs and cannot maintain relationships.

ENT doctors often perform surgeries on sleep apnea patients to remove adenoids, tonsils, nasal polyps or tissue that blocks airways, but studying sleep medicine takes research a step further. The author is currently enrolled in a Masters of Sleep Medicine at the University of Sydney that offers a more multi-disciplinary background and shows that some sleep apnea patients are not being adequately treated, often only being recommended one treatment approach such as a CPAP or a dental appliance.

I manage sleep apnea patients on referral from a medical team and fit them with dental appliances when a CPAP isn't tolerable and surgery isn't needed or desired. These oral devices are used for those patients with mild to moderate sleep apnea and work by repositioning the lower jaw and the tongue to increase the oropharyngeal airway. However, in many cases patients may require a multidisciplinary mode of treatment that involves CPAP; surgery to the nose and/or soft palate; reduction of allergies; diet/weight loss/exercise; and a mandibular advancement device to achieve an adequate reduction in their apnoea/hypopnea index (AHI) score.

Patients need to know all their options. Although other options are available, CPAP is the most effective treatment for nearly all patients. A prescription for CPAP follows a sleep study (polysomnograph or PSG) being conducted in a controlled and moni- tored setting. Patients should at the very least try the device for several weeks before seeking an alternative treatment option.

Regardless of what treatment is prescribed, proper and close follow-up is essential for all sleep aponea patients, including repeat sleep tests. Even when snoring - a common symptom of sleep apnoea - is eliminated, a person may still have the sleep disorder. Losing weight doesn't always fix the problem either. Some thin people have sleep apnoea. Facial structure can play a role. No medications work reliably well unless the disorder is mild and can be attributed to chronic allergic rhinitis that may respond to anti histamine and inhaled corticosteroid medications.

Often times, patients who don't find success with the CPAP may not return to the practitioner for follow-up treatment, which puts their health at greater risk. Last month, the American Stroke Association linked severe sleep apnea to increased risk of silent strokes and small lesions in the brain. The key is to get a proper diagnosis, seek treatment and understand that, if a CPAP device doesn't work for whatever reason, alternatives are available, such as dental appliances.

Depending on the mechanism of action, oral appliances are divided into sets: repositioning of the tongue (TRD), anterior repositioning devices of the man- dible (MAP or MRAs), lifting the soft palate and uvula repositioning (ASPL) and oral appliances positive pressure (OPAP)[1] (Table 1).

Table 1. Intraoral appliances according to their mechanism of action

- Anterior positioning appliance of the tongue or tongue retainer (TRD)
- Mandibular advancement prosthesis (MAP)
- Devices for lifting the soft palate and uvula repositioning (ASPL)
- Positive pressure oral appliance (PPOA)

Table 2. Anterior repositioning of the tongue (TRD)

- SNORX
- TRD (Tongue Retaining Device)
- TLD (Tongue Locking Device)
- TOPS (Tepper Propioceptive Oral Stimulator)

Table 3. Elevation of the soft palate and uvula repositioning

- ASPL (Adjustable Soft Palate Lifter)
- Equalizer (Equalizer Airway Device)

1. Tongue-retaining device (TRD)

These devices have a cavity in the anterior part of the device that keeps the tongue in a more advanced position, increasing the distance between it and the posterior pharyngeal wall (Fig. 1).

2. Devices for lifting of the soft palate and uvula repositioning

These devices act by raising the soft palate and uvula to a higher position, thus eliminating the snoring (Table 3) (Fig. 2).

3. OPAP Devices

(Oral Pressure Appliance)They are a combination of mechanical ventilation from the CPAP and oral appli- ances. Oral devices are connected to the tube of the CPAP (Fig. 3).

4. Mandibular advancement appliance (MRAs)

Appliances for repositioning the mandible represent the most useful design in the range of oral appliances. Their mechanism of action is to anteriorly reposition the mandible and indirectly reposition the tongue, with the aim of expanding the size of the upper airway during sleep.

Table 4. Prótesis de avance mandibular (PAM) Monoblock

- NAPA (Nocturnal Airway Patency Appliance)
- Snore Guard
- Mandibular Advancement Positioners (PM Positioner)
- (Elastomeric Sleep Appliance)
- OSAP
- Mandibular position held by hooks (Class Retained Mandibular Positioner)
- Tilted Mandibular Repositioning Splint (TMRS)

Appliance for 2 blocks (Fixed Advancement and Adjustable Advancement)

- Bionator
- Elastic Mandibular Advancement Appliance: EMA
- Herbst
- IST - Herner (Intraoral Snoring Treatment)
- Jasper Jumper
- Klearway
- Garry Prior Modification
- PPP Posterior Flat Guide (PFG)
- SAS of Zurich
- TOSP (Tepper Oral Stimulator Propioceptive)
- NAPA (Nocturnal Airway Patency Appliance)


Fig. 1. Tongue retaining device.

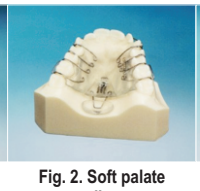
Fig. 2. Soft palate appliance

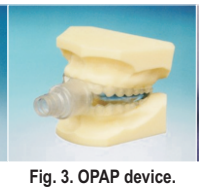
Fig. 3. OPAP device.

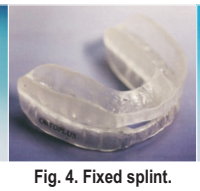
Fig. 4. Fixed splint.


Fig. 5. Adjustment splint.

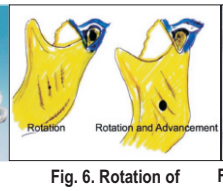

Fig. 6. Rotation of the mandible.

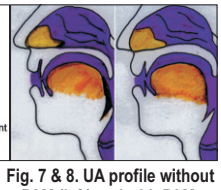
Fig. 7 & 8. UA profile without PAM (left) and with PAM.

- Equalizer Airway Device
- Elastic Positioner
- ASPL (Adjust Soft Palate Lifter) with Airway expansion
- Snore-Guard
- SNOAR (Sleep and Nocturnal Obstructive Apnea Reducer)
- DIAMR
- Twin-Block
- TRD (Tongue Retaining Device)
- OPAP (Oral Pressure Appliance Prototype)
- Silensor (Silent Nite)

There are two types of appliances, depending on whether the bite is fixed (Figure 4) or adjustable (Figure 5) i.e. the mandibular advancement can be titrated (adjusted progressively) (Table 4).

Mechanism of action

Oral appliances can improve the permeability of the upper airway (UA) during sleep by expanding its size and/or decreasing its collapsibility (by improving muscle tone in the UA). It has been dem- onstrated that an MRA can extend the UA at various points, both on the soft palate and the base of the tongue. There is a predominant lateral expansion of the UA, but there is also developments in the anter- oposterior region whereby pharyngeal collapse disappears and the critical pres- sure decreases. Intraoral devices essentially perform a propulsion advancement and clockwise rotation of the mandible. The condyle rotates and moves earlier in the glenoid cavity, thus creating an increase in the section of the UA, although this also involves other pathophysiological neuromuscular mechanisms.

While sleeping, the mandible drops back with the same posterorotation, influencing an increase in resistance of the UA. In fact, 69% of the time, patients with OSA, sleep with their mouth open, more than 5 mm. This is a significantly higher figure than in healthy individuals (11%), and such increased opening of the mouth can produce a posterorotation with increased resistance to the UA (Fig. 6). This phenomenon helps explain how a significant improvement is seen with little mandibular repositioning, even without major changes in the airways. This is achieved by simply avoiding the retropo- sitioning of the mandible[2] to be stabilized by the intraoral device (Fig. 7 and 8).

Other changes occur at the palatopharyngeal level, consisting of increased rigidity and widening between the anterior and posterior pillars (palatopharyngeal and palatoglossus muscles) of the pharynx and a generated increase in lateral pharyngeal wall. This increase is larger than increasing the pharyngeal lumen. In the anteroposte- rior direction, a displacement of the soft palate forward and an increased caliber velopharyngeal level significantly reduces snoring or makes it disappear. At the lingual level, anterior rotation of the mandible and an increased vertical dimension is consistent with this opening, activating and tightening of the muscle that plays the major role: i.e. the genioglossus. It has been found via electromyographic studies that the genioglossus muscle tone increases significantly after application of intraoral appliances.[3]

With the use of an MRA, the tongue occupies a more anterior space,[4] avoiding the anterior drop and hence the blockage of the airway. The various pressures at the level of pharyngeal wall plays a decisive role in the collapse of this zone. Intraoral devices certainly alter this balance of pressure, facilitating permeability[5] of the UA. During cardio- pulmonary resuscitation[6] or to prepare the airway during resuscitation, the mandible is pulled down and out to open the airway. Mandibular propulsion changes the position of the hyoid bone forward, which facilitates the permeability of the airspace above it. This has been proven in several studies.[7] Using different techniques (CT, MRI, electro- myography, plestimography etc) these positive changes have been demonstrated by several researchers[8,9] (Fig. 9-12).

We would also like to think that there is a correlation between the degree of man- dibular advancement and the improvement or disappearance of apnoeic events/oxygen desaturation. This is to some extent true and has been proven in several studies.[10] There are clear short-term reductions in the number of sleep apnoeas, the oxygen desaturation and subjective sleepiness in patients with OSA. Snoring is reduced in frequency and intensity. In the long term, snoring and apnoeas/ hypopnoeas during sleep are reduced to levels comparable with results in cases treated surgically (Table 5).

Table 5. Action of prosthetic mandibular advancement

- They tense the soft tissues of the side walls of the pharynx.
- Partial of total reduction of soft tissue vibration that causes snoring.
- Activation of genioglossus muscle and increased muscle tone of the tongue.
- Changes in pharyngeal pressures to normalize physiological properties of UA.

Intraoral appliances

Appliances for the treatment of snoring and sleep apnoea can be classified in many ways. From the functional point of view, as discussed above, the devices are distinguished by proponents of the jaw (mandibular advancement splint); or tongue repositioning (retrainer tongue devices) (TRD). Within the mandibular advancement devices, there are a further two groups, a one-piece element and two-piece duo-blocks, also called splints (Fig. 13 and 14).

They are all made of differing materials with varying degrees of adaptation to the patient's dentition. The characteristics of each differ in occlusal coverage, regulation of mandibular advancement, lateral movement, vertical dimension settings, permissiveness of oral breathing and impediments to the desired mouth opening. There are more than three hundred mandibular advancement devices and it would be a daunting task to describe every one of them. In the next article, we will describe the best known. The most commonly used in clinical practice are those of independent splints which are connected to the top and bottom by different mechanisms such as pipes, rods, hooks, elastics, ball joints, mechanics, magnetism, etc (Fig. 15-18).

References

References are available on request at editor@healtalkht.com

About the author

Dr. Mahony is a Sydney-based specialist orthodontist who has been actively involved in research that links constricted maxil- lary archforms to nasal breathing problems, adverse facial growth and systemic health problems such as nocturnal enuresis. He has presented over 400 lectures on orthodontic topics in more than 50 countries. As a practising clinician, Dr Mahony's research interests are in the aetiology of malocclusion and the guidance of facial growth. He references the Orthoapnea manual as the source of the information contained in this 6 part series of articles.

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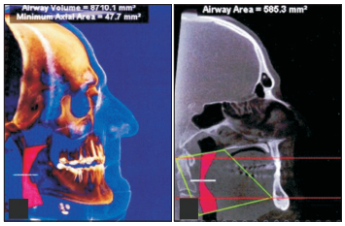

Fig. 9a-b. Cone-beam CT in patients without OSA treatment.

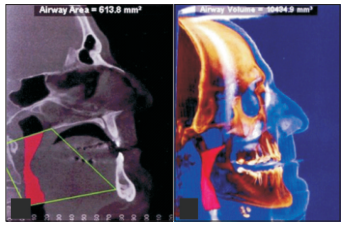

Fig. 10a-b. OSA patients TAC with an intraoral device.

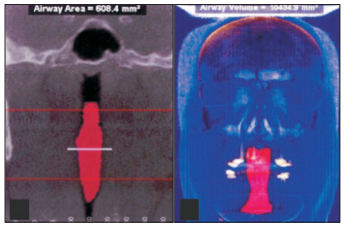

Fig. 11. (a) Frontal plane without intraoral appliance in place. (b) Frontal plane with intraoral appliance in place.

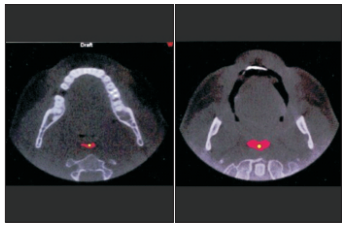

Fig. 12. (a) Transversal plane intraoral appliance in place. (b) Transversal plane with intraoral appliance in place.

Fig. 13. One piece MRA.

Fig. 14. Two piece MRA

Fig. 15. Herbst splint..

Fig. 16. EMT appliance.

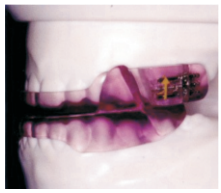

Fig. 17. SomnoMed MAS.

Fig. 18. Orthoapnea appliance.