Intraoral Appliance Therapy for the Treatment of Chronic Snoring and OSA

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"There is a growing evidence base to support the use of oral appliances in the treatment of OSA. Recent data from randomized controlled trials suggest that oral appliance therapy is effective in controlling OSA in over 80% of patients..."

Snoring can be defined as an inspiratory noise produced by the passage of air, in a narrow area of the upper airway, that makes the soft palate vibrate with the surrounding tissues.[1,2] The prevalence of snoring, in the general population, is 25% for men and 14% in women. Upon reaching adulthood, this figure increases dramatically, especially after the fourth decade, where it increases proportionally with age. So we can say that the prevalence of snoring in the age range of 40-65 years is 60% for males and 40% in women. That means that almost half the adult population snores or has snored sometime in their lives.

When snoring is accompanied by a clinical picture of breathing pauses and daytime sleepiness, the condition is diagnosed as sleep aponea-hypoponea syndrome (OSA). This is characterized by episodes of obstruction of the upper airway during sleep resulting in a reduction (hypopnea) or complete cessation of airflow (aponea). Prevalence of OSA in Australia is 4-6% in men and 2-4% in women.[3] In Spain, the prevalence is 2-4% according to various studies and the condition is more common in individuals over 40 years old. It is estimated that between 1,250,000 and 2,500,000 patients suffer from these ailments, however, OSA has only been diagnosed and treated in only 5-9% of the population.[4]

Currently there are a variety of effective and fully documented treatment modalities available. All treatments, for snoring and OSA, are governed by a common goal, i.e. to increase the diameter of the airway and reduce the resistance of the UA, thus ensuring an immediate improvement in the quality of life for many patients. These patients recover to normal sleep patterns and reduce the risks to their health, no longer triggering apneic events that would decrease their life expectancy.

The treatment of OSA varies according to the specific constraints of each patient and can include conservative treatments such as weight reduction or postural changes and in more severe cases, CPAP usage and surgery. Current therapies consist of positive pressure breathing (CPAP), surgical (uvulopalato-pharyngoplasty) and intraoral appli- ances. For patients requesting non-invasive treatments, oral appliances are the most effective option and produce very acceptable results.

Evolution of Intraoral Appliances

The use of oral appliances for the treatment of snoring and OSA is not new. The use of intraoral appliances in the treatment of obstructive sleep pathologies dates from a very long time ago. Pierre Robin[5] describes in 1902 the use of a functional appliance called the "monobloc" which positions the jaw forward, thereby preventing the tongue from falling backwards (glossop- tosis). He used this in patients with severe mandibular hypoplasia. Robin's earlier designs were applied in cases of mandibular micrognathia with mandibular hypoplasia in children. In the 80's[6] the generalized use of these devices, as an alternative to the monopoly of CPAP, has offered patients a new therapeutic dimension. These appliances overcame the drawbacks of the irreversible and invasive surgery and the annoying mechanisms of positive ventilation (CPAP) that have low levels of acceptance.

Since the introduction of oral devices for the treatment of snoring and Obstructive Sleep Aponea, numerous devices have been designed and are currently available on the market. These oral appliances include intraoral mandibular advancement appliances, positioners of the tongue, lifting devices of the soft palate and uvula, repositioning and oral positive pressure devices. Clinical trials of existing oral applications demonstrate that the mechanisms of mandibular advance- ment (with titration) have the highest level of efficiency.[7] The literature now describes more than three hundred devices aimed at solving the problem of snoring and sleep apnea. The American Association of Sleep Disorders defines intraoral devices as those whose mechanics are aimed at changing mandibular propulsion by influencing the position of the tongue and other secondary structures.

The SEPAR magazine of 1993 referred to alternatives to CPAP in these terms: "They have tried numerous systems or 'gadgets' in the treatment of OSA, such as systems of advancement of the tongue, nasopharyngeal tube, oral prostheses, electrical stimulation of the pharyngeal muscles, etc. So far, none of these systems have been successful, so they are not currently recommended."[8] The latest clinical investigations disagree with these state- ments. From our current experience, we would qualify that this point of view is outdated and ill-advised, since it does not reflect the current reality of OSA patients. Our clinical experience demonstrates that the prosthetic mandibular advancement treatment is the easiest option, as it causes the patient less pain and better levels of adaptation and acceptance. Intra oral appliances are less cumbersome than the bulky continued pressure masks (Table 1).

Table 1 : Nomenclature of Intraoral appliances

IA	Intraoral Appliances
OA	Oral Appliances
DAM	Dispositivo Avance Mandibular MAD Mandibular Advancing Devices PAM Prótesis de Avance Mandibular
MAP	Mandibular Advancement Prosthesis
MAS	Mandibular Advancement Splint

Continuous positive airway pressure (CPAP) has been the treatment of choice for decades, but it has its disadvantages, e.g. rejection and intolerance. This impedes optimal patient compliance with therapy so this therapeutic approach has lost its competitive edge over other avail- able alternatives. These shortfalls have led to the need to work on other solutions that are equally effective but more tolerable. There is a growing interest in the use of oral prostheses and more specifically mandibular advance- ment devices. These systems have undergone major technological develop-ments in recent years and now constitute one of the best treatments of choice for people with snoring and OSA.[9] The success of such appliances is based on the fact that advancement of the mandible has a very positive impact in increasing the diameter of the upper respiratory tract and in the recovery of its functionality.

There are many types of oral appliances with potential advantages over CPAP. Dental splints do not generate annoying noises, do not need a power supply and are potentially less expensive and more portable with a lower psychological impact. There is also a growing evidence base to support the use of oral appliances in the treatment of OSA. Recent data from ran- domized controlled trials suggest that oral appliance therapy is effective in controlling OSA in over 80% of patients, including patients with more severe forms of the disease. This is associated with a significant improvement in symptoms such as snoring and daytime sleepiness. Although direct comparisons to CPAP indicates the superiority of CPAP, in general, we have found similar results between the two treatments in a substantial subset of patients. Based on the subjective experience of patients, who have used both appliances, the greater acceptance has been for oral devices.[10]

Patient selection for Intraoral Appliances

Guidelines issued by the American Academy of Sleep Medicine and pub- lished in the February 2006 edition of Sleep, state that "the use of oral appliances are indicated in patients with mild to moderate OSA. These patients may have had failed attempts with

CPAP." The guide- lines also state that oral appliances should be installed by qualified dental personnel trained and experienced in the general care of oral health, temporo-mandibular joint dysfunction, dental occlusion and oral structures.

A sleep study is needed to verify the effectiveness of oral appliance therapy and is especially necessary when symptoms worsen or persist. OSA patients who are treated with oral appliances should have follow-up visits with the dental clinic to regularly monitor proper patient wear, assess possible damage to the device and to assess the health of the oral structures plus the integrity of the occlusion. Regular monitoring is also necessary to assess patient signs and symptoms, or the potential worsening of the OSA.[11]

The application of oral devices is indicated for the majority of patients with OSA. The improvement in the design, mechanism and effectiveness of existing devices on the market ensures effective treatment in all patients with few exceptions. The American Sleep Association provides a generic protocol to establish a profile of candidates for oral appliance therapy (Table 2).

Table 2. Candidates for treatment with intraoral appliances

- Patients with mild OSA who do not respond favourably to conservative measures.
- Patients with moderate or severe OSA who refuse or do not respond well to treatment with CPAP, who refuse or are unfit for surgery and those who do not improve after surgical treatment.

The recommendations on the use of intraoral appliances, as a first choice, are:

- Patients who snore, with snoring as the main symptom.
- Patients with mild OSA.
- Patients with mild-moderate OSA and a low BMI.
- Patients with UARS.
- Patients whose lifestyle includes frequent travel.

As an indication of second choice for:

- Patients with rejection or intolerance to CPAP.
- Patients where surgical treatment has failed.
- Patients who use CPAP with a nasal or mouth nasal mask and also maintain an intraoral appliance in the mouth.

We must first consider that the majority of aponeas are those considered mild or moderate, i.e. not exceeding 40 events per hour. Even though we know that treat- ment of nasal continuous positive airway pressure (CPAP) is consistent in the administration of a continuous flow of air to "open the airway" and is a highly effective treatment, it is remarkable that the dropout rate of long-term CPAP therapy is very high (around 70% use it less than 4 hours per night).[12] This lack of compliance is primarily due to the inconvenience of this treatment option. Patients complain of dry mucous membranes, irritation by misalignment of the mask, the restriction of movements in bed, discomfort to turn over during sleep or psychological reasons increasing their anxiety and claustrophobia. In the case of oral appliances, cross-sectional studies have highlighted that the levels of compliance are well above CPAP users. The default rate in patients with intraoral devices is higher in those patients with a mandibular advanc ment appliance,[13] which is 24% compared to those with other intra oral appliances, where the dropout rate is only 5%. Studies assessing the long-term monitoring of the use of intraoral appliances highlights 6.8 hours per night.[14,15]

Among the most common factors for the patient to stop using the oral device are discomfort and lack of motivation. Given these limitations, it should be emphasized that when making an oral appliance, the materials should be as comfortable as possible and the technician should perform a series of checks to establish the adaptation and proper use of the device. On the other hand, it is important to conduct studies to assess that the AHI is in the normal range i.e. less than or equal to 5. At this point, it is noteworthy that the differences in design between appliances is not a negligible aspect in the success of the therapy. The type of device required significantly affects the acceptance of patients who best accommodate new appliance designs such as an Orthoapnea appliance (Fig. 1). This appliance allows lateral movement, maximum opening and easy titration as compared to the uncomfortable stationary monoblock style appliances (Fig. 2).

The indication for CPAP treatment is reserved to a series of patients with an AHI above 40 or falling between 15-30 who manifest symptoms related to hypopnea and cardiovascular risk (hypertension, obesity, etc). The ideal solution is to individualize treatment for each patient and prescribe appropriate dietary measures to promote weight loss. Finally, patients with an AHI > 30 without symptoms, or hereditary factors and cardiovascular risk, may be recommended for intraoral appliance therapy as the treat ment of choice (Table 3).

Table 3 : OSA severity according to AHI

No OSA	<5 events per hour
Mild	<20
Moderate	Between 20 and 40
Severe	>40

The criteria for treatment with intraoral devices are:

- The primary symptom is snoring;
- Rescue of surgical treatment (Uvulo-palatopharyngoplasty);
- Rejection or intolerance to CPAP; or
- Psychological disturbances, or frequent maladjustment with the mask.

Cases that contradict the use of oral appliance therapy would be:

- Drowsiness as the main symptom;
- Dentition inappropriate e.g. active periodontal disease without treatment;
- Uncontrolled obesity; or If there is significant O_2 desaturation.

In summary, if snoring is the most striking symptom and there is an absence of excessive hypoxemia, intraoral devices are the treatment of choice. If there is a significant sleepiness, a CPAP response may be indicated. In some cases, patients can benefit from both treatments, for example, when

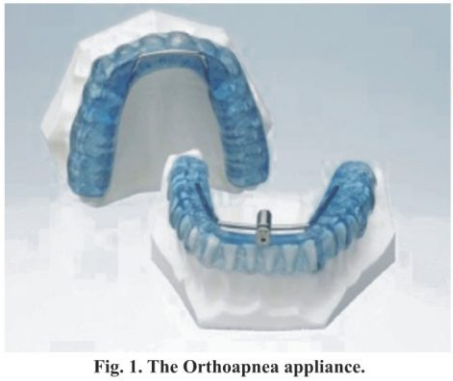

Fig. 1. The Orthoapnea appliance.

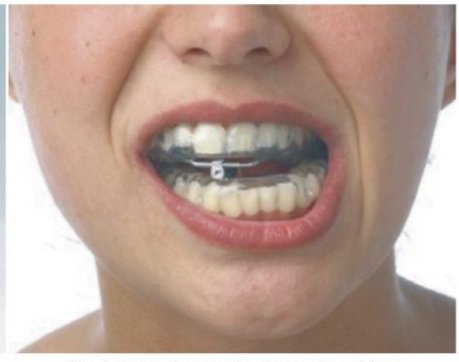

Fig. 2. Lateral excursion is easy to achieve with this appliance.

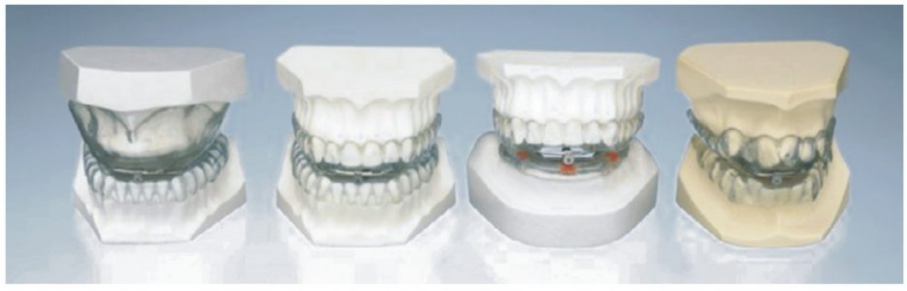

Fig. 3. The evolution of intra oral mechanisms make oral appliances viable in any dentition, including edentulous patients, or patients with removable prostheses and implants.

travelling they can wear the intraoral appliance and at home can use the CPAP machine. Lack of teeth is not a disadvantage since the evolution of different intra oral mechanisms make oral appliances viable in any dentition, including edentulous patients, or patients with removable prostheses and implants (Fig. 3). The clinician will need to conduct a thorough review of the patient's dentition and in the pres- ence of periodontal disease or other dental abnormality, the dental problem must be corrected before prescribing the appliance if fitted. The patient should have the ability to advance the mandible and open their mouth fully without significant limitations. Serious problems in the TMJ or insufficient capacity of protrusion may be a contraindication for therapy with oral devices

Possible Side Effects

In the short term, side effects of intraoral appliance use can include excessive sali- vation and sensitivity of the teeth or jaws. These are the most common complaints in oral appliance users. These setbacks usu- ally disappear over time. In the longer term, changes to the occlusion are more common. The cause of the changes arise from the forward and vertical displace- ment of the mandible to prevent UA collapse during sleep. The forces that are produced tend to increase the normal dis- tance between the upper and lower teeth and bite opening on their backs. A 1mm change in dental occlusion occurs in about a third of patients after five years, but these changes are not serious.

Repositioning of the mandible for airway management takes advantage of the attachment of the tongue to the mandible. This new position shortens the lateral pterygoid muscle which then needs to be stretched back to its full working length. Any discluding device will seat the condyle and the simplest solution for this is not a device but DAILY stretching of the muscle. To stretch the lateral pterygoid muscle:

1. Open your mouth.
2. Put the tip of your tongue up and back as far as possible towards the soft palate.
3. Keeping the tongue up and back, slowly close your jaw until first tooth contact
4. Keep biting down until the back teeth come into contact or the “bite” returns. Once this is done, after you take the oral appliance out, the lateral pterygoid muscle will stay OK. If you are unable to return the lower jaw to its starting position, then discluding appliances can be added. 10% of people using a sleep device will experi- ence a bite change. Of those, less than 1% will be bothered by it or require treatment, but clearly it needs to covered as part of informed consent.

The research by Ueda et al[20] suggests muscle stretching exercises to relieve tension in masticatory muscles that may lead to occlusal changes. The aim of this study was to compare the effects on objective occlusal function of two types of jaw exercises during oral appliance therapy in patients with OSA. 16 consecutive subjects with snoring or OSA undergoing oral appliance therapy were included in this study; the results were based on 10 patients who completed it. The patients were randomized to start with either a jig exercise or stretching movements for 1 month; after 1 month without exercise, they crossed over to the other exercise for 1 month. An occlusal diagnostic system that consisted of a pressure-sensitive sheet and an image scanner was used to evaluate occlusal contact area and bite force. Both exercises produced significant increases in occlusal contact area and bite force in the morning compared with the period of no exercise. At night, the molar region had significant improvements in occlusal contact area and bite force only during stretching movements. They found no significant differences between the 2 exercises, but stretching movements tended to be more effective in the molar region, whereas the jig exercise tended to be more effective in the anterior region. Jaw exercises might help relieve masticatory muscle stiffness and accelerate the repositioning of the mandible to the normal position, in addition to inhibiting or minimizing the occlusal functional changes in predisposed patients.

Side effects of intraoral devices are classified as:

a) Cephalometric changes: mandibular advancement of 0.1 mm. This is negli- gible from a practical point of view.
b) Changes in occlusion are more promi- nent but have no impact: reduction of the overjet (0.1-1.3mm) or the overbite (0.1-1.8mm), upper incisor proclination of 2 degrees, lower incisor retroclina- tion of 4 degrees, displacement of the upper molars (0.4mm).
c) Symptoms of any removable ortho- dontic appliance placed in the mouth include increased salivation, jaw dis- comfort, toothache, facial and dental sensitivity, especially of the incisors in the morning. This discomfort is reduced by repeatedly biting on an elastomeric tab. Discomfort is more frequent in monoblock devices. Adverse effects are more significant in mandibular advance- ment appliances. In patients who are given a further advancement, we would expect more complications but this has not been demonstrated by the long-term research with intraoral appliances.[16-19]

The success of oral appliance therapy can vary based on treatment indications, the manufacturing process, adaptation and monitoring. The whole process may take weeks or months and should be done in collaboration with a sleep unit. Adjust- ments should be made periodically, depending on the case and reviews per- formed on an annual basis especially in the more difficult to control cases.

References

1. Koskenvou M., Partinen M., Kaprio J. Snoring and disease. Ann Clin Res. 1985; 17:247-51.
2. Hans M.G., Goldberg J. Cephalometric examination in obstructive sleep apnea. OralMaxillofac. Surg Clin North Am. 1995; 7:269-81.
3. Young T., Palta M., Dempsey J., et al. The occurrence of Sleep dis- orders breathing among middle aged adults. N Engl J Med.1993; 328:1230-6.
4. Durán-Cantolla J., Mar J., De la Torre G., Rubio R.,Guerra L. El síndrome de apneas-hipopneas durante el sueño (SAHS) en España.Disponibilidad de recursos para su diagnóstico y tratamiento en los hospitales del estado español. Arch Bronconeumol. 2004; 40:259-67.
5. Robin P. Glosoptosis due to atresia and hypotrophy of the mandible. Am J Dis Child. 1934; 48:541-7.
6. Bear S.E., Priest J.H. Sleep apnea syndrome. Correction with surgi- caladvancement of the mandible. J Oral Surg. 1980; 38:543-9.
7. Hoffstein V. Review of oral appliances for treatment of sleep-disor- dered breathing. Sleep Breath. 2007 Mar; 11(1):1-22.
8. Diagnóstico y tratamiento del síndrome de apnea obstructiva del sueño (SAOS). SEPAR 1993.
9. Fiz J.A. Prat J. y Jane R. Tratamiento del paciente con ronquidos simples Arch Bronconeumol. 2009; 45:508-15.
10. Ng A., Gotsopoulos H., Darendeliler A.M., Cistulli P.A. Treat Respir Med. 2005; 4(6):409-22. Review.
11. Kushida C.A.; Morgenthaler T.I.; Littner M.R., et al. Practice param- eters for the treatment of snoring and obstructive sleep apnea with oral appliances: An Update for 2005. SLEEP 2006; 29(2):240-243.
12. Meslier N., Lebrun T., Griller-Lanoir V., Roland N., Henderick C., Sailly J.C., et al. A French survey of 3,225 patients treated withCPAP for obstructive sleep apnoea: beneficts, tolerance, complianceand quality of life. Eur Respir J. 1998; 12:185-92.
13. Ferguson K.A., Ono T., Lowe A.A., Al-Majed S., Love L.I., Fleetham J.A. A short term controlled trial of an adjustable oral appli- ance for the treatment of mild to moderate obstructive sleep apnea. Thorax. 1997; 52:362-8.
14. Lowe A., Sjoeholm T., Ryan C., et al. The effects of klearway oral appliance on airway size and obstructive sleep apnea. Sleep. 2000; 23:S172-8.
15. Bondemark L., Lindman R. Craniomandibular status and function in patients with habitual snoring and obstructive sleep apnea after nocturnal treatment with a mandibular advancement splint: a 2-year follow-up. Eur J Orthod. 2000; 22:53-60.
16. Gosoptoulos H., Chen C.,Quian J., et al.Oral appliance theraphy improves symptoms in obstructive sleep apnea: a randomized con- troled trial. Am J Respir Crit Care Med. 2002; 166:743-8.
17. Metha A., Quian J., Petocz P. A randomized controlled study of a mandibular advancement splint for obstructive sleep apnea. Am J Respir Cri Care Med. 2001; 163:1457-61.
18. Martínez Gomis J., Willaert Jiménez-Pallarejo E., Nogués Pujol, et al. Efectos adversos del uso de una férula de avance mandibular en el tratamiento de los transtornos respiratorios del sueño. Revisión de la literatura. Archivos de Odontoestomatología. 2004; 20:88-100.
19. Ringqvist M., Walker-Engstrom M.L., Tegelberg A., et al. Dental and skeletal changes after 4 years of obstructive sleep apnea treat- ment with a mandibular advancement device: a prospective randomized study. Am J Dentofac Orthop. 2003; 124:53-60.
20. Ueda H, Almeida FR, Chen H, Lowe AA. Effect of 2 jaw exercises on occlusal function in patients with obstructive sleep apnea during oral appliance therapy: a randomized controlled trial.Am J Orthod Dentofacial Orthop. 2009 Apr;135(4):430.e1-7; discussion 430-1.

About the author

Dr Mahony is a Sydney-based specialist orthodontist who has been actively involved in research that links constricted maxillary archforms to nasal breathing problems, adverse facial growth and systemic health problems such as nocturnal enuresis. He has presented over 400 lectures on ortho- dontic 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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