Review Article

Oral Appliances in the Management of Obstructive Sleep Apnoea Syndrome

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Abstract

Obstructive sleep apnoea (OSA) is a term used to describe repetitive episodes of complete or partial upper airway obstruction that occur during sleep. It is a highly prevalent medical disorder and a challenge to treat. The treatment options include continuous positive airway pressure, oral appliances and surgical interventions depending on the severity of the condition. Among these, oral appliances are commonly used as primary therapy for the treatment of OSA because these appliances are designed to either encourage maxillary transverse development or advance the mandible, which will significantly reduce the OSA. This narrative review emphasises the role of various oral appliances in the treatment of OSA and will serve as a guide to clinicians in choosing the proper dental appliance.

Keywords: Obstructive sleep apnoea, oral appliances, paediatric sleep-disordered breathing

Introduction

Obstructive sleep apnoea (OSA) syndrome is defined as a disorder of breathing during sleep characterised by prolonged partial upper airway obstruction and/or intermittent complete obstruction (obstructive apnoea) that disrupts normal ventilation during sleep and healthy sleep patterns.[1] Recurrent episodes of total (apnoea) or partial (hypopnoea) obstruction of the upper airway simultaneously with respiratory effort at rest lead to chronic sleep deficiency, and the individual suffers from all its consequences.[1] Studies show that children with only primary snoring present behavioural changes and cognitive deficits when compared to healthy children.[2] It is now recognised that significant morbidity is seen in paediatric OSA.[2]

OSA is a common sleep disorder that can be potentially fatal. This serious disease condition greatly diminishes the quality of life of affected individuals and impacts their state of health unfavourably.[3] Treatment of patients with OSA not only improves their physical health but also their mental and social well-being.[4] This review aims to provide an overview of the role of dental professionals in the management of OSA.

Aetiology

Snoring is often the result of the base of the tongue obstructing the upper airway. The oropharynx includes the tongue, teeth, maxilla, mandible, the hard and soft

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Figure 1: Silensor

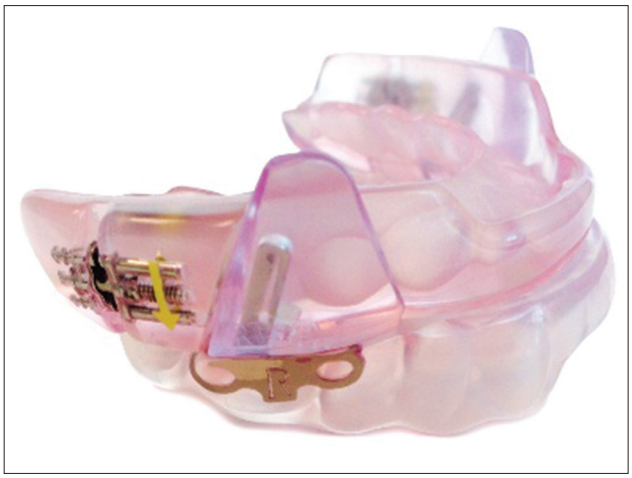

Figure 2: SomnoDent Fusion

Figure 3: SomnoDent Flex

Figure 4: SomnoDent Classic

Figure 5: SomnoDent SUAD

Figure 6: SomnoDent SUAD Ultra

palates, uvula, tonsils and the hyoid bone, which is involved in the muscular action of the oral cavity.[1] When a patient falls asleep in the supine position, muscle relaxation causes the base of the tongue to approach the posterior pharyngeal wall.[5] With the consequent reduced air flow, the patient must increase the speed of the air flow to maintain the required oxygen supply to the lungs.[6] This increase in airflow velocity causes vibration of soft tissues and produces snoring.

Figure 7: SomnoDent Alpha

Figure 8: Morning Repositioner

Figure 9: DreamTAP®

Figure 10: MyTAP™

Figure 11: ApneaRx

Figure 12: Blue PRO

Role of Dentists and Paedodontists

Dentists play a vital role in the identification of risk factors by screening patients for OSA syndrome through appropriate history taking, general and physical examination and evaluation of the anatomy of oral cavity and jaws during dental visits. Similarly, there will be a posteriorly positioned soft palate adjacent to the pharyngeal wall, with the uvula not being seen even during phonation.

Figure 13: Adjustable Thera Snore

Figure 15: Dyna Flex Milled Dorsal

Figure 17: Silent Nite SL

The best treatment plan can be made only by an interdisciplinary team approach including different specialities such as ear, nose and throat surgeon, paediatrician, sleep expert team and dental surgeon (especially the paediatric dentist).

Figure 14: Oasys with nasal dilators

Figure 16: Dyna Flex Milled Herbst

Figure 18: Snore Cure

As OSA syndrome is more commonly seen in children, early identification of OSA is essential so that appropriate treatment can be rendered, thereby avoiding the development of various long-term complications in adulthood. Paediatric dentists are

Figure 19: Oniris

Figure 20: The Luco Hybrid OSA Appliance

Figure 21: Good Morning Snore Solution

Figure 22: Elastic mandibular advancement

Figure 23: Oravan Herbst

Figure 24: O2Vent W

most likely to identify OSA syndrome. Patients with OSA may exhibit both extraoral and intraoral features such as adenoid facies, high-arched palate or unilateral/bilateral crossbites, macroglossia, micrognathia and retrognathia. Once the paediatric dentists recognise children with any of these intra- or extraoral features, they should inform the parents regarding the risk of developing OSA and further information about the importance of sleep test. Having these benefits, the involvement of paedodontist in the treatment process of OSA syndrome can significantly reduce the severity

Figure 25: Panthera digital sleep apnoea device

Figure 26: Prosomnus continuous advancement sleep-and-snore device

Figure 27: Prosomnus

Figure 28: Narval CC

Figure 29: Clear sleep appliance

Figure 30: Oasys adjustable Herbst appliance

of the condition at an early stage, preventing later problems and complications.

Patient Selection

Patient selection plays a vital role in any treatment to be done. This often requires a skilled multidisciplinary team approach. Guidelines published by the Association of American Sleep Disorders about the appropriate use of oral appliance therapy (OAT) define the respective

Figure 31: Respire Blue EF+

roles of the physician as well as the dentist.[7] The initial patient assessment, differential diagnosis of sleep complaints and overnight diagnostic monitoring by the sleep specialist determine the indications for treatment with a suitable oral appliance.[8]

Appliance Selection

The selection of the oral devices is based on various patient features, including the need for lateral mobility, tongue space, ease of fitting, durability, ease of adjustment and overall personal experiences.[9-11] Oral appliances are of two types – prefabricated and custom-made. Prefabricated appliances are most commonly used in Western counties, but the disadvantage of using such appliances is improper fit to the oral structures. Custom-made appliances are fabricated by the dentist with the help of a dental laboratory technician. These are available in two forms - with the help of clasps and using thermoforming type. Custom-made devices have the advantages of being smaller, more durable and comfortable and therefore have higher retention.

Treatment Options

Treatment options for OSA are divided into three categories (in increasing degree of invasiveness):

1. Continuous positive airway pressure (CPAP)
2. Oral appliance therapy
3. Surgical intervention

Continuous positive airway pressure

The concept of nasal CPAP is to maintain upper airway patency during sleep by using a nasal mask, oral mask or other variations.[12] Because of its effectiveness, CPAP is the first-line treatment, though its success is limited by the patient's level of compliance. Patient intolerance of CPAP is due to nasal dryness, facial ulcerations at the mask interface and claustrophobia.[13]

Surgical intervention

The main surgical treatment offered for OSA often targets the anatomical areas of the posterior airway where collapse is suspected to occur. Surgery has the advantage of correcting any craniofacial abnormalities that may have caused the OSA and of removing the variable of patient compliance with long-term treatment.[14] Studies also reported that maxillomandibular advancement surgery, which is based on traditional orthognathic surgery technique, has proven effective for OSA.[15]

Oral appliances

The use of oral appliances has been shown to be effective in subsets of patients with OSA.[16] Many commercial devices offer treatment for snoring. However, a device designed to treat OSA should be fabricated by a dentist familiar with device design, maintenance and therapeutic efficacy. Such devices should be customised on the basis of a referral from a sleep team.[17]

Types of Oral Appliances

The appliances used in the treatment of OSA are generally classified into two categories: mandibular advancement splints (MAS) and tongue-retaining devices (TRD). Various types of oral appliances are as follows:

Silensor

It is a MAS which is one of the successful oral appliances used for OSA. It consists of two separate formings which fit over the maxillary and mandibular arches [Figure 1]. Any additional opening of the mouth increases the forward displacement of the mandible. Regardless of using the *Silensor*, the lower jaw movement is possible. Because it is of minimum bulk, it is a comfortable and effective anti-snoring aid. *Silensor* has shown a high success rate in individuals where breathing through the nose is difficult or blocked.[18]

Silensor is contraindicated in cases of myofascial dysfunction, temporomandibular joint (TMJ) disorders, TMJ arthropathy and advanced periodontal condition.

SomnoDent

These are custom-fitted dental devices developed for the treatment of snoring and OSA syndrome by moving the lower jaw forward. It is usually fabricated by the dentist in dental lab in conjunction with a physician. By wearing this appliance during sleep, the lower jaw will be moved forwards into a comfortable position. By allowing relaxation of the tissues and ensuring that the base of the tongue does not collapse and block the airway, the individual is assured of a safe and noise-free sleep. The advantages of using this device are that it is easily adjustable, highly adaptable and very strong. It also does not cause any restriction of movement, allowing the patient free opening and closing the mouth. It is indicated in the treatment of nocturnal snoring and mild-to-moderate OSA. This device is contraindicated in patients with central sleep apnoea, severe respiratory disorders, loose teeth, advanced periodontal disease and those under the age of 18 years.[19]

Based on the severity and diagnosis, there are different modifications of the *SomnoDent* that are available:

SomnoDent Fusion

SomnoDent fusion [Figure 2] features custom calibration with flexibility that reduces the frequency of resets that would leave patients without their appliances during manufacturer adjustments. Drop-in fit and fewer adjustments save dental practices both time and money.[19]

SomnoDent Flex

It is made with a unique SMH BFlex material [Figure 3]. The flex has a soft inner liner which maintains retention and offers premium patient comfort.[19]

SomnoDent Classic

It is a customised oral device that is held in place using medical-grade stainless steel ball clasps [Figure 4]. The advantage of this appliance is that it allows more space for the patient's tongue.[19]

SomnoDent SUAD

It is the earliest version of SUAD Elite, with a casted frame that traces the arches, creating strength [Figure 5]. The modified Herbst design grants the lateral movement and easy titration. In this, the complete arch is totally encapsulated by casted substructure to ensure that the dentition will not move.[19]

SomnoDent SUAD Ultra

Formerly the SUAD Ultra Elite, it offers the patient increased tongue space, with a unique anterior design [Figure 6]. It is also entirely encapsulated by the casted substructure, ensuring that the dentition will not move.[19]

SomnoDent Alpha

It is a new transitional mandible repositioning anti-snoring device with a fully adjustable and flexible design that helps patients to sleep immediately [Figure 7]. It should be used safely up to 90 days to evaluate patient's clinical response to mandibular advancement.[19]

Shift in the right direction: The Morning Repositioner

It is a hands-free bite deprogrammer designed to help return the patient's mandible to its normal position. The unique design of this appliance incorporates raised blocks of compressible material strategically placed directly above the bicuspids [Figure 8]. This directs all clenching forces straight down towards the roots rather than laterally or forwards onto the anterior teeth.[19]

DreamTAP®

It works by advancing and stabilising the jaw and preventing airway collapse [Figure 9]. It has an optional compliance monitor chip which is a characteristic feature of this appliance. It is made up of cobalt-chromium metal; the trays are composed of durable polymer, with two types of the inner lining (triple laminate or ThermAcryl) designated by the clinician.[20]

My TAP™

It works on the same principle as Dream TAP. The duration of fabrication is 15 min, allowing for same-day treatment and immediate relief. The adjustment protocol is titrating the device 1/2 turn (1/4 mm) every 2–3 nights until the desired treatment position is achieved [Figure 10].[21]

ApneaRx

It works on the principle of advancing the mandible in precisely marked 1 mm increments. The appliance is fabricated of soft thermal plastic and hard acrylic [Figure 11]. Fitting takes < 10 min. It provides 1 mm adjustment and locking capability with a 10 mm range.

Blue PRO

It is a first-step trial device fitted chairside by trained dental professionals. It is made up of Rilsan plastic splints (no latex or Bis-phenol A) with thermoplastic lining [Figure 12]. Upper and lower splints are united

to form the finished appliance before reinserting in the mouth to find the appropriate degree of the mandibular protrusion.[22]

Adjustable Thera Snore

It is made up of soft thermal plastic moulded on hard acrylic [Figure 13]. It is worn on the maxillary arch, which gently holds the mandible in a protruded position. Total elimination of TMJ discomfort is appreciated because the mandible has complete vertical and lateral freedom of movement. It has an appropriate protrusion setting and is snapped back together at the desired setting via a locking mechanism.[23]

Oasys with nasal dilators

The device works by repositioning the mandible. The nasal dilators correct nasal breathing and the tongue buttons enhance tongue position [Figure 14]. A removable bracket can be placed for combination therapy with CPAP.

Dyna Flex Milled Dorsal

It is a mandibular advancement device. It is available in three different materials or liners: all acrylic with ball clasps, comfort fit (hard–soft liner) and Accu-Fit (thermacrylic liner). The forward advancement of the mandible helps in opening the airway [Figure 15].

Dyna Flex Milled Herbst

It is a mandibular advancement appliance. The forward placement of the lower jaw helps to gain an airway opening. The device has telescoping arms that can advance the mandible up to 5 mm [Figure 16]. These advancements are done with the help of a small key.

Silent Nite SL

It works by positioning the mandible in a forward position using special S-shaped connectors. These connectors are attached to the upper and lower trays, which increases the volumetric capacity of the airway [Figure 17]. It is made up of soft polyurethane inner layer and a hard co-polyester outer layer which are Bis-phenol A free.

Snore Cure

It is made up of a medical-grade soft plastic durable material that provides mandibular protrusion by allowing vertical and lateral excursions [Figure 18]. The tapered occlusal design prevents subluxation of the condyle, thereby avoiding TMJ discomfort. The closed version supports proper nasal breathing.

Oniris

It combines a simple custom-fitted tooth print [Figure 19]. The design has a vertical opening of the jaw, which is not limited to a single position, and an adjustment mechanism is also incorporated in the device with a 1 mm accuracy. It opens the patient's airway through the advancement of the mandible. It is made up of a soft inner liner which maintains retention; in hard plastic which provides dimensional stability.[24]

Luco Hybrid OSA Appliance

It is the only Food and Drug Administration-cleared appliance used in the treatment of OSA with concurrent sleep bruxism. It uses a forward bite registration to activate the masseter inhibitory reflex to treat sleep bruxism while managing OSA and symptoms due to upper airway resistance syndrome [Figure 20].

Good Morning Snore Solution

It uses tongue displacement technology to address the primary cause of snoring in a noninvasive way. It works on the principle by gently pulling the tongue forward and keeping it in place. The mouthpiece clears blocked airways, resulting in an easier, more comfortable sleep [Figure 21]. It is a 'one-size-fits-most' mouthpiece and requires no special fitting by a sleep specialist.[25]

Elastic mandibular advancement

The primary treatment mechanism of this appliance is by opening the bite and gently moving the mandible forwards with the use of interchangeable elastic straps [Figure 22]. The advantage of this appliance is that it offers varying degrees of mandibular advancement.

Oravan Herbst

The device opens the patient's airway through the advancement of the lower jaw using an adjustable telescopic Herbst system [Figure 23]. Similar to Oravan device, it has an open anterior design, encouraging natural protrusion of the tongue with maximum patient comfort.

O2Vent W

The slim-line O2Vent W has an adjustable dual mechanism to stabilise jaw position and advance the mandible to reduce airway collapse by enabling mouth opening [Figure 24]. It allows breathing through the device to bypass obstruction in the nose.

Panthera digital sleep apnoea device

It is a custom-made appliance in which the design is

fabricated with the help of a computer [Figure 25]. The device holds the entire mandible in a forward position, thereby increasing the space behind the tongue, which facilitates airflow and eliminates snoring. Due to materials, it is ideal for patients with bruxism also.

Prosomnus continuous advancement sleep-and-snore device

It is a constant advancement protocol in which continuous advancement of the arch is done by employing a split 90° post with embedded expansion screw [Figure 26]. It is made up of pre-polymerised, milled polymethylmethacrylate (PMMA).[26]

Prosomnus

It is an iterative advancement sleep-and-snore device with monogram customisation. It utilises vertically mated buccal posts to advance and hold the mandible forward to open the airway [Figure 27]. It is made up of pre-polymerised, milled PMMA.

Narval CC

It uses an optimised articulation method that maintains the mandible in an advanced position, opening the upper airway to enable effective treatment [Figure 28]. It is a computer-aided design and manufacturing device. Each appliance is fitted specifically to the patient by the dentist.[27]

Clear sleep appliance

It is comprised of two lightweight Bis-phenol A free trays, which allow the lateral movement of the tongue and provide maximum room for advancing the mandible forwards [Figure 29]. It is made up of pressure-moulded polycarbonate or hard acrylic with ball clasps.

Oasys adjustable Herbst appliance

Made of hard acrylic with clasps, Oasys adjustable Herbst appliance advances the mandible with the help of bilateral telescopic hinges [Figure 30]. The device is arranged by placing the upper and lower portions together.

Respire Blue EF+

It maximises the tongue space by using a thin, durable chrome material on the lingual and anterior areas. Additional support is given by the four-wing design [Figure 31]. The adjustment screw allows advancement up to 6 mm. It is made up of acrylic and chrome.

Adverse Effects

Most of the adverse effects caused by oral appliances are mild and transient, occur during the initial phase of therapy and tend to resolve with time.[28] The common side effects of mandibular repositioning devices (MRDs) include malocclusion and TMJ pain. TMJ dislocation is common, but most resolve within 2 months.[29] Adverse reactions with TRD are tongue abrasion, oral mucosal dryness, excessive salivation and gagging.

Follow-up

During follow-up visits, the dentist should observe appliance usage, side effects, complications and the degree of advancement of the appliance.[29] In case of any side effects or any adjustments, further advancement or even replacement with a different device is indicated.[30] The recall period is advisable at 2 weeks and 1 month, and thereafter every 6 months.

Comparison of Oral Appliance Therapy with Other Therapies

Studies report that there is no significant difference in reduction in apnoea-hypopnoea index (AHI) while using monobloc and two-piece appliances in terms of both lateral movement and jaw opening.[9] A retrospective analysis reported that fixed devices found a higher treatment response rate as compared to adjustable devices.[10] A cohort study performed on tongue protrusion using an anterior tongue bulb reported more significant AHI reduction compared to mandibular advancement alone.[9] Recently introduced minimally invasive laser dentistry provides the option for performing non-ablative tightening of the uvula, soft palate and surrounding tissues with a fractional Er:YAG laser handpiece. This treatment known as NightLase® has many benefits. It does not need anaesthesia as there is no pain and it constitutes only three short 20-min sessions with immediate results.[31]

Conclusion

OSA has significant life-threatening consequences. The condition needs an early multispeciality treatment approach, particularly for developing children. One of the major causes of OSA is adenotonsillar hypertrophy. In identifying and treating OSA in children, dentists can play a vital role in determining any abnormality of the tonsils while examining the children's mouths and informing the child's parents and the primary

care physician. Intraoral appliances in children are advisable, especially in mild-to-moderate cases of OSA, but only after a complete orthodontic assessment of the child's growth and development.

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Conflicts of interest

There are no conflicts of interest.

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