

A Review

Obstructive Sleep Apnoea : A Review

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Abstract

Upper airway is a collapsible compliant tube. As such it has to be able to withstand suction pressures generated by rhythmic contractions of diaphragm that sucks air into the lungs. This is accomplished by the rhythmic contractions of upper airway muscles such as genioglossus (tongue) and the hyoid muscles. In addition to the rhythmic innervation from the respiratory centre in the medulla oblongata, the motoneurons controlling the muscles also receive tonic innervations that sets a baseline level of stiffness and size. Thus this tube is kept patent by various protective reflexes and normal tone of the surrounding muscles. Many treatment approaches have been used in the management of this condition. Oral appliances play a major role in the management of OSA and have become the first line of treatment in almost all patients suffering from OSA.

INTRODUCTION

Upper airway is a collapsible compliant tube. As such it has to be able to withstand suction pressures generated by rhythmic contractions of diaphragm that sucks air into the lungs. This is accomplished by the rhythmic contractions of upper airway muscles such as genioglossus (tongue) and the hyoid muscles. In addition to the rhythmic innervation from the respiratory centre in the medulla oblongata, the motoneurons controlling the muscles also receive tonic innervations that sets a baseline level of stiffness and size. Thus this tube is kept patent by various protective reflexes and normal tone of the surrounding muscles. During sleep, the muscles relax causing soft tissues in the back of throat to collapse, hence decreasing the size and stiffness of the airway. But in some people, this muscular laxity increases to such an extent that the tongue falls backwards, towards the posterior pharyngeal wall and causes obstruction to airflow. The obstruction to airflow may be partial or complete, leading to snoring (due to vibrations of the soft palate by passage of air through the narrowed airway), partial reductions of airflow (hypopnoea) and complete pauses (apneas) in breathing during sleep. Most pauses last between 10 and 30 seconds, but some may persist for one minute or longer. This can lead to abrupt reductions in blood oxygen saturation, with oxygen levels falling as much as 40 percent or more in severe cases. The brain responds to the lack of oxygen by alerting the body,

causing a brief arousal from sleep that restores normal breathing. This pattern can occur hundreds of times in one night. The result is a fragmented quality of sleep that often produces an excessive level of daytime sleepiness.¹ This condition is known as Obstructive sleep Apnoea. Obstructive sleep Apnoea (OSA) was first described in medical literature in 1965.² Daytime symptoms such as excessive sleepiness are thought to be related to sleep disruption (repetitive arousals) and possibly to recurrent hypoxemia. It is a relatively common condition occurring in 2 to 4 % of males and 1 to 2 % of females in middle age.³ There are many causes of OSA like obesity, age, enlarged tonsils, narrower natural throat form, smoking and alcohol use etc. The severity of OSA must be established in order to make an appropriate treatment decision.⁴ Obstructive sleep apnoea is also a risk factor for various heart diseases and type 2 diabetes.⁵ The cardinal features of OSA are snoring, sleep apnoea (usually reported by family members) and sleepiness during daytime that results in occupational deficits and an increased risk of automobile accidents.⁶

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Classification

The American Sleep Disorders Association Arbitrarily classifies OSA⁷:-

- Mild AHI: 5-15
- Moderate AHI: 15-30
- Severe AHI: > 30

Causes & Risk Factors

Weight⁸ – In many cases a person's body weight is directly linked to having obstructive sleep apnea. People who are overweight or obese are more likely to have sleep apnoea than those that maintain a healthy weight. Sleep apnoea can often be caused by excess fatty tissues that become built up in the neck and throat. This can lead to restrictions in airflow as the upper respiratory system's pathway is narrowed or pinched off during sleep. Age⁹ – As people age their muscles begin to lose muscle tone. This is also true of the muscles in the throat. As throat muscles lose definition, they become weaker and more likely to collapse into the airways during sleep. Gender⁹ – Men have a greater risk for OSA. Skeletal¹⁰ – Retropositioned maxilla and mandible. Enlarged tonsils or adenoids¹¹ are the leading cause of obstructive sleep apnoea in children but can also affect adults who never had a tonsillectomy when they were younger. Natural causes¹² – some people can be genetically predisposed to having a narrower throat or may have an enlarged tongue that falls back into their airway. Habitual snoring¹³ – Many, but not all individuals with sleep apnea experience symptoms of snoring, gasping and choking during sleep. Family history¹⁴ – Inherited characteristics in the face and neck can cause breathing abnormalities. Menopausal state¹⁵ – in a prospective follow-up study of many individuals of the Wisconsin sleep cohort, Young and colleagues identified an important increase in the frequency of apnoea in postmenopausal women compared with those who had not reached menopause, independent of their age. Immune abnormalities¹⁶ – IL-6 and TNF-alpha may both play a role in obesity as well. Smoking¹⁷ – smoke is an irritant to the lungs, throat and oesophagus. It can cause inflammation and fluid retention in the upper airways that can impede airflow. Systemic illnesses¹⁸ – Hypothyroidism, acromegaly, amyloidosis, vocal cord paralysis, Marfan's syndrome and Down syndrome. Individuals with severe heartburn (Gastroesophageal reflux disease, or GERD) appear to be at higher risk. Neuromuscular disorders¹⁹ – post polio syndrome can result in inadequate neuromuscular control of the upper airway and lead to obstructive sleep apnoea. Drugs²⁰ – increases the degree of relaxation of the upper airway muscles and interfere with the brain's arousal ability. Cerebrovascular lesions²¹ – Patients with moderate to severe OSA have a higher prevalence of silent cerebrovascular lesion than with less severe OSA. Race²² – Apnoea is more frequent in African Americans than in white people.

Diagnosis

- History taking
- Physical examination

- Objective testing
- Patient education
- Oximetry

Investigations

- Radiographs
- Computed tomography (ct)
- Magnetic resonance imaging (MRI)
- Cone beam computed tomography (CBCT)

Treatment Plan

Selection of treatment(s) for individual OSA patients should be based upon balanced consideration of disease severity and site(s) of obstruction, subjective symptoms, risks of morbidity and mortality and patient choice.

Nonspecific Therapy

These measures should be included in the treatment of all patients with OSA but should be used exclusively only in patients with very mild apnea whose main complaint is snoring. Overweight persons can benefit from losing weight. Even a 10% weight loss can reduce the number of apneic events for most patients.²³ Individuals with apnea should avoid alcohol four to six hours prior to bedtime and also sleeping pills, which might collapse the airway during sleep and prolong the apneic periods.²⁴

Specific Therapy

The specific therapy for sleep apnea is based on medical history, physical examination and the results of polysomnography.²⁵ Medications are generally not effective in the treatment of sleep apnea. Pharmacological agents like thyroid hormone supplementation might lead to significant correction of the apnea if this is the sole problem. Control of blood sugar levels has, however, had at best a moderate effect in controlling the diagnosed obstructive sleep apnea. Certain medications which increase respiratory drive help some patients. Progesterone, a hormone secreted at a high rate during the third trimester of pregnancy, has been used with some degree of success in men and women alike. Tricyclic antidepressants Protriptyline in low doses has been used in people with mild apnea and snoring with mild success. It increases upper airway neuromuscular activity and decreases REM sleep. Patients with mild apnea have a wider variety of options, while those with moderate to severe apnea should be treated with nasal CPAP. Positive airway pressure is a very effective therapy for OSA. It has three forms: 1. Continuous positive airway pressure (CPAP) 2. Autotitration 3. Bi-level positive airway pressure. Positive airway pressure is a very effective therapy for obstructive sleep apnea. In 1981 Drs. Sullivan, Berthon- Jones, Issa and Eves from Australia published the first account of treating sleep apnea patients with continuous positive airway pressure (CPAP) thus initiating the common and successful treatment, currently known, for this disorder. CPAP is indicated for the treatment of the moderate to severe OSA (standard) and mild OSA (Option). CPAP is also indicated for improving self-reported sleepiness (standard), improving quality of life

(Option), and as an adjunctive therapy to lower blood pressure in hypersensitive patients with OSA (Option)²⁶.

Surgery

Historically surgical procedures used for management of OSA have included intranasal procedures, reduction glossectomies, uvulopalato pharyngoplasty procedures and tracheostomy.²⁷ Disadvantages are the pain and expense of surgery and the relatively poor long-term success rate, as most of these procedures address the obstruction at only one level, are some of the reasons why surgery has not been the preferred treatment of choice for OSA.²⁷ Surgery may be appropriate for patients who cannot comply with or are not appropriate candidates for conservative therapies. Tonsillectomy is an important component of surgery for OSA, especially if the tonsils are enlarged. The removal of redundant tissue by tonsillectomy increases the caliber of the throat thereby reducing blockage to breathing. Genioglossus tongue advancement procedure produces a larger space between the back of the tongue and the throat thereby creating a wider airway. Complications resulting from this procedure are very uncommon. UPPP involves the removal of part of the soft palate, uvula and redundant peripharyngeal tissues, sometimes including the tonsils. This procedure is often effective in eliminating snoring. Maxillomandibular advancement (MMA) or double jaw advancement is a procedure where the upper and lower jaws are surgically moved forward. The concept is that as the bones are surgically advanced, the soft tissues of the tongue and palate are also moved forward opening the upper airway. Since the upper and lower teeth are moved the same amount, the bite would be similar before and after surgery. This type of treatment is usually done if previous procedures have not completely improved the obstructive breathing episodes and the patient has persistent symptoms of daytime sleepiness and fatigue. The operation advances the tongue base and epiglottis forward thereby opening the breathing passage at this level. Tracheostomy is one of the oldest, most shunned and least understood procedures for OSA. The concept with this procedure is that any area of blockage to breathing, from the nose to the voice-box, is bypassed by a hole placed into the windpipe. This stoma must be maintained both by daily cleaning and by insertion of a tube. The tracheotomy tube must be kept exquisitely clean otherwise painful infections of the stoma will occur or the tube and/or windpipe could become blocked with secretions. When OSA is severe and CPAP is not tolerated or ineffective or cardio-pulmonary failure has developed, tracheotomy may be the initial treatment of choice. Some patients who cannot tolerate CPAP and for whom other measures have failed may require tracheostomy.

Oral Appliances

Patients with mild to moderate OSA are candidates for placement of appropriate oral devices.²⁸ Dental appliances may prevent snoring and OSA by modifying the position of the upper airway structures so as to enlarge or reduce collapsibility of the airway.²⁹ The use of intra-oral appliances

is simple, non invasive, reversible and cost effective and may be the basis of definitive lifelong treatment.

Advantages of Oral Appliances

- Relatively simple.
- Reversible and
- Cost effectiveness.

Disadvantages of Oral Appliances

Complications of appliances could be loosened teeth, joint pain, muscle aches, tissue sores, inability to touch the posterior teeth together when the appliance is first removed in the morning, permanent tooth movement and excessive salivation. Studies have shown that long-term use of appliances which moved the jaw forward resulted in permanent tooth repositioning in as many as 20% of patients.

Tongue Retaining Devices

The tongue retaining device was first developed by a physician in 1979. It is a bubble shaped device made of soft polyvinyl. The patient's teeth rest in custom fitted grooves which are extended to form a 'bubble' that sticks out from between the lips.³⁰ The patient positions his teeth in the grooves, sticks his tongue forward into the bubble until suction grabs and holds the tongue in place. Positioning the tongue forward may eliminate any obstruction caused by the base of the tongue.³⁰ It is most useful in patients with very large tongues, poor dental health, no teeth, chronic joint pain or if their sleep apnea is worse when lying on their backs than when they lie on their sides at night. The device cannot be used in people who are tongue-tied, overweight that they are more than 50% above their ideal body weight, grind their teeth at night, or have chronically stuffy noses.



Figure 1- Tongue retention device

Thornton Adjustable Positioner (TAP)

It is a custom made two piece adjustable appliance that is worn while sleeping. The trays of the appliance snap over the upper and lower teeth and hook together. The design is based on the same principle as cardiopulmonary resuscitation (CPR). The airway must be opened to allow air to pass through the throat. The TAP holds the lower jaw in a forward

position so that it does not shift nor fall open during the night. This prevents the airway from collapsing. The more you pull your jaw forward, the more your airway will open. The TAP is the only mandibular advancement device that can be adjusted easily by the patient or practitioner while in the mouth. This feature allows the patient to always be in the control of their treatment. The unique design also allows the patient to fine tune their treatment position at home to achieve maximum results.



Figure 2- TAP (Thornton Adjustable Positioner)

Herbst Telescopic Appliance

It has been proven to be effective on chronic snoring and mild to moderate OSA sufferers. This appliance allows patients to move laterally and vertically without disengaging the appliance³¹. The mandible can easily be moved forward by two options of adjustability. The first option is traditional hardware with sets of 1,2 and 3 mm shims for advancing those increments only. The second being the telescopic version allowing the clinician to advance in 1/4 mm increments by making one full turn of protrusion collar upto 6-8mm from the start position. The appliance can be fabricated from hard acrylic, thermoactive and soft materials and is tooth retained via friction grip or clasps. The herbst appliance is a mandibular repositioner that has been in use many years for orthodontic and TMJ therapy prior to its modification for treatment of sleep disordered breathing.³¹ The greatest advantage of the herbst appliance is that it allows for quick, easy and accurate mandibular protrusive adjustability. This is accomplished through simple manipulation of the rod/sleeve plunger mechanism.



Figure 3- Herbst Telescopic Appliance

Norad

It is an autotitratable immediate placement mandibular repositioning device for the management and treatment of snoring and sleep apnea. The appliance which is fabricated chairside, works by repositioning the lower jaw downward and to a slightly more forward position.

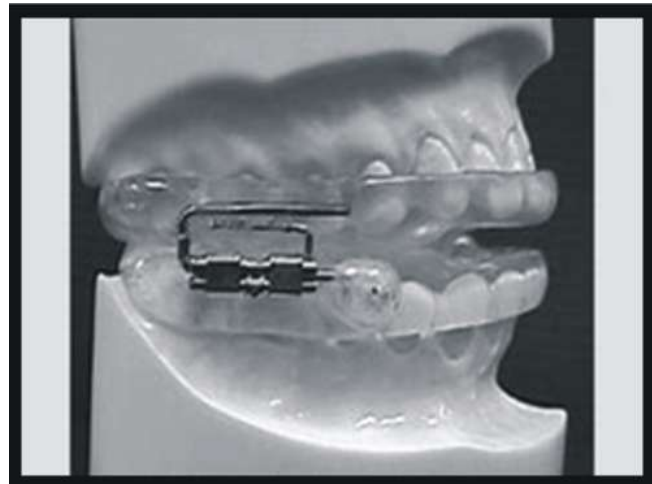


Figure 4- PM Positioner

PM Positioner

PM Positioner which links upper and lower splints with bilateral orthodontic expanders has attachment connectors on both lateral sides.³² This appliance is made of a thermoplastic material which must be heated in hot tap water every night before it is placed in the mouth. The adjustment hardware is rigidly bound on the buccal side of the molar teeth and allows no movement of the bottom jaw while the appliance is worn.³²

Z Appliance

The z appliance is a combination of a soft palate lifter and a mandibular advancement device (the herbst).

Klearway Oral Appliance

The Klearway oral appliance utilizes a maxillary orthodontic expander to sequentially move the mandible forward. Klearway is a fully adjustable oral appliance used for the treatment of snoring and mild to moderate OSA.³³ Fabricated of thermoactive acrylic, Klearway provides easy insertion and confirms securely to the dentition for an excellent fit. Small increments of mandibular advancement are initiated by the patient and this prevents rapid jaw movements that cause significant patient discomfort.³³ Lateral and vertical jaw movement is permitted which enables the patient to yawn, swallow and drink water without dislodging the appliance.



Figure 4- Klearway TM Oral Appliance

CONCLUSION

As dental professionals, we have a significant role to play in the early diagnosis, management and care of patients suffering from sleep apnea. Many treatment approaches have been used in the management of this condition. The success rates of these procedures are however relatively low. Oral appliances play a major role in the non surgical management of OSA and have become the first line of treatment in almost all patients suffering from OSA.

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