

REVIEW ARTICLE

Obstructive Sleep Apnea And Orthodontics Part 2- Treatment Overview

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ABSTRACT

Obstructive Sleep Apnea is a chronic sleep related breathing disorder requires long term, multi disciplinary management. Various treatment modalities such as behavioral, medical, surgical options are available. OSA treatment modalities range from sleep hygiene, which involves withdrawal from alcohol and other drugs, proper sleep position, and weight reduction, to surgical procedures such as glossectomy, uvulopalatopharyngoplasty, and maxillomandibular advancement procedures. The most common clinical procedure involves continuous positive airway pressure (CPAP). Orthodontic management of OSA syndrome could be provided to children as a preventive and interceptive modal or to adults by an interdisciplinary management. Oral appliances are simple, non invasive, cost effective and reliable treatment method compare to all other airway pressure therapy and surgical approach in mild and moderate OSA patient.

Keywords: Apnea, CPAP, Maxillo mandibular advancement, Obstructive sleep apnea, Oral appliance, Soft tissue surgery.

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INTRODUCTION

Chronic obstructive sleep apnea (OSA) is a sleep related breathing disorder affecting all ages characterized by periodic breathing cessation (apnea) or airflow reduction (hypopnea). Overweight middle-aged adult men have the highest prevalence of the disease, yet women and an increasing number of children are also affected by OSA .

Clinically OSA is defined by the occurrence of day time sleepiness, loud snoring, witnessed breathing interruptions ,or awakenings due to gasping or choking in the presence of 5 obstructive respiratory events (apnea,hypopnea or respiratory effort related arousal)per hour of sleep.

The main objective of OSA treatment should be aimed to normalize breathing during sleep and eliminate un necessary day time sleepiness.¹

At the same time, it should provide patients with a good quality of life with no side effects or risks . There are behavioral, medical and surgical options are available for the management of the OSA. Treatment effectiveness is variable and dependent on patient needs. It is believed that treatment must be evaluated over time for good patient outcome

Treatment modalities

The American association of sleep medicine (AASM) conclude CPAP is the gold standard treatment for OSA. They suggested apart from this eight surgical and five conservative treatment approaches for OSA. Dentofacial surgical procedures mandibular advancement and maxilla mandibular advancement and genioplasty also listed in their treatment option. Oral appliances are Conservative way of management of OSA.²

Nonspecific therapy

Non specific therapy should be considered in all OSA patients. Mild apneac patients are more beneficial with this approach.

Obesity

Obesity is the major risk factor for the development of OSA, it is thought to be associated with anatomic alterations that predispose to upper airway obstruction during sleep, by increasing adiposity around the

pharynx and body. Fatty cells infiltrate the throat tissue, possibly narrowing the airways. Central obesity has been associated with reduction in lung volume, which leads to a loss of caudal traction on the upper airway, and hence, an increase in pharyngeal collapsibility. Subjects with severe obesity, BMI of >40, the prevalence of sleep apnea was markedly increased to 40-90 per cent. It was well demonstrated that a 10 per cent body weight reduction was associated with a parallel 26 per cent decrease in AHI.³ Thus, weight reduction is an important conservative treatment for sleep apnoea.

Smoking and alcohol consumption

Cigarette smoking and alcohol have been shown to be risk factors for OSA. Smoking is associated with a higher prevalence of snoring and sleep-disordered breathing. In Winconsin Sleep Cohort Study, current smokers had a much greater risk of moderate or worse degree of OSA compared with non smokers.⁴ It can well be explained by the cigarette induced airway inflammation and damage which could change the structural and functional properties of the upper airway, and increasing the risk of collapsibility during sleep.

Alcohol, a frequently self-prescribed mind altering substance has been shown to clearly increase AHI. Alcohol relaxes upper airway dilator muscles, increases upper airway resistance and may induce OSA in susceptible subjects. Therefore, alcohol intake can prolong apnoea duration, suppress arousals, increase frequency of occlusive episodes and worsen the severity of hypoxaemia,⁵ However, alcohol use should be discouraged and when alcohol ingestion has changed significantly, the OSA severity and treatment should be reassessed.

Numerous sedating medications worsen OSA and/or cause central sleep apnoea, particularly clonazepam, quetiapine, methadone, lorazepam, diazepam.,

Specific Therapy

The specific therapy for sleep apnea is planned according to the individual patient, based on their medical history, physical examination, and the results of polysomnography. Medications alone are generally not effective in the treatment of sleep apnea.

MEDICAL INTERVENTION

Oxygen administration

Oxygen administration is advisable in central apnea cases. But some individuals with chronic lung diseases it worsens the apnea. This method will not eliminate excessive daytime sleepiness. Nevertheless it reduce the degree of oxygen desaturation and

arrhythmia.^{6,21}

Endocrine disorders

There are several endocrine conditions that may present as OSA, signs and symptoms of some hormonal imbalances overlap with OSA symptoms especially in hypothyroidism individuals.

Thyroid hormone supplementation might lead to significant correction of the apnea if this is the sole problem. OSA is extremely common in patients with acromegaly (>50%) but this is an extremely uncommon clinical condition (1 in 25,000 individuals). Patients with acromegaly may have both central and obstructive sleep-disordered breathing events. Grunstein and colleagues⁷ discovered that patients with central sleep apnoea events have higher growth hormone levels and insulin-like growth factor-1 levels, suggesting a link between growth hormone and sleep-state dependent respiratory control. Treatment with a long-acting somatostatin analogue, octreotide improves the AHI whether or not growth hormone levels normalize.

Medication

In general, medications play a limited role in the treatment of OSA. Protriptyline, a tricyclic antidepressant, 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. Protriptyline is not considered primary therapy for OSA. Protriptyline and fluoxetine suppress rapid eye movement (REM) sleep and may reduce apnoea in some cases, but the side effects outweigh the marginal benefits.⁸ Nasal steroids and decongestants are effective in reducing nasal symptoms. Other medications such as progesterone, theophylline, and acetazolamide are not recommended.

Positive Pressure Therapy

Positive airway pressure is a very effective therapy for obstructive sleep apnea. It may be delivered in 3 modes: continuous positive airway pressure (CPAP), autotitration and bi-level positive airway pressure. Sullivan et al first published the benefits of CPAP for OSA patients in 1991.^{9,25}

MECHANISM OF CPAP

CPAP is the most common positive airway pressure therapy. Nasal or facial mask is supported by Velcro strips and it is connected to small air compressor, thus CPAP machine administers air under pressure. It keeps the upper airway open and prevent airway collapse. Positive airway pressure is easy to tolerate only at

low pressure. Individuals optimum airway pressure can be determined by means of polysomnogram. The effectiveness of CPAP is evaluated in 32 moderate OSA patients in a randomized control trial in 1994. Their mean AHI is 28. Mean period of 3.4 hrs per night provides significant improvement, improved cognitive function, quality of life and their mood.¹⁰

In an other randomized control study 34 patients with mild OSA (defined as an AHI of 5-15 plus subjective sleepiness were evaluated. Engleman et al²⁸ again found an improvement in symptoms, subjective sleepiness, quality of life, and cognitive function, which was achieved by the use of CPAP for a mean of only 3.5 hours. Compared with the group receiving sham CPAP treatment (in which the pressure was set to 3 cm H₂O and the mask contained extra air leaks).

Jenkinson et al¹¹ reported a greater improvement in both subjective and objective sleepiness when active CPAP was used for a mean of 5.3 hours. Thus, CPAP improves symptoms across the full range of OSA severity and confers more benefits in the moderate-to-severe groups.

The potential advantage of CPAP is tissues are prevented from collapsing during sleep, and apnea is effectively prevented without surgical intervention. Quality of life improves, Survival rates may increase, Daytime sleepiness improves or resolves, Heart function and hypertension improve.

To determine optimum air pressure, first patient must be monitored in sleep laboratory. Other problems encountered during CPAP treatment is wearing uncomfortable mask, the machine sound, sensation of suffocation, nasal congestion, sore eyes, conjunctivitis, sore throat, skin rashes. In Auto titration, positive pressure therapy it is possible to change the pressure value based on the patient needs.

Bi-level positive airway pressure¹² is a variation of CPAP. In CPAP, patients have a discomfort to exhale against the high airway pressure. In bilevel positive therapy this particular problem is eliminated by modifying the pressure machine design.

Oral Appliances

Oral appliances have been recommended as a treatment option for being simple to use and non-invasive.¹³ Oral appliances are designed to increase the upper airway volume and prevent the airway collapse through a mechanical maneuver.^{14,15} Oral appliances are comfortable to wear, economical, easy to use and good patient compliance.³⁴⁻³⁶ Several studies demonstrate that oral appliances can be a useful alternative to positive air way pressure with mild to moderate sleep apnea.^{16,17} There is also robust

evidence of the efficacy of oral appliances for improving polysomnographic indices and modifying the health risk associated with OSA.¹⁸

Oral device may be helpful in the management of OSA by; improving upper air way potency, increasing the cross sectional area or decreasing the upper air way collapsibility by increasing the muscle tone. The US FDA approved 16 devices for use in sleep apnea oral appliances as an alternative to CPAP therapy. They are designed to keep upper air way open.¹⁹

During sleep all the gravity dependent tissues tends to fall back posteriorly, oral appliance prevent the tongue fall back by means of tongue retaining devices, other group of oral appliances advance the mandible in a forward position. By this way, airway remain patent reducing the apneic and hypopneic events. Side effects of Mandibular advancement devices are overbite alteration, tooth pain, and TMJ problems.²⁰

Nelly et al²¹ investigated the efficacy of orthopedic mandibular advancement and/or rapid maxillary expansion in the treatment of pediatric obstructive sleep apnea. A total of 58 studies were identified. Only eight studies were included in the review; of these, six were included in the meta-analysis. Although the included studies were limited, these orthodontic treatments may be effective in managing pediatric snoring and obstructive sleep apnea. Other related health outcomes, such as neurocognitive and cardiovascular functions have not yet been systematically addressed.

SURGERY

Surgery may be appropriate for patients who cannot comply with or are not appropriate candidates for conservative therapies or CPAP alone. Historically, surgical procedures for OSA treatment have included intranasal procedures, reduction glossectomies, uvulopalatopharyngoplasty procedures, and tracheostomy; Careful and thorough preoperative examination by radiography, imaging, and direct visualization is needed to identify the airway obstruction site(s) and to select the appropriate surgery.

Soft Tissue Surgery

Surgical correction has been used with the goal to improve soft tissue anatomy and function. But evidence has shown that any improvement gained from soft tissue surgery is not lasting and has only a limited improvement.

Treatment Type	Measures used
Conservative	- Lose weight, sleep in lateral position, avoid alcohol
Medical	- Use Nasal continuous positive airway pressure, auto-continuous positive airway pressure, bilevel positive airway pressure - Use oral appliances - Give medication - Treat associated diseases, eg hypothyroidism, acromegaly, Allergic rhinitis
Surgical	- Tracheostomy - Nasal procedure, eg turbinectomy, polypectomy, septoplasty - Uvulopalatopharyngoplasty - Laser-assisted uvulopalatoplasty - Maxillo-mandibular advancement
Experimental	- Pharyngeal pacing - Radio-frequency ablation - Rapid maxillary expansion

Table-1: Various Treatment modalities³

Uvulopalatopharyngoplasty (Uppp)²²

Uvulopalatopharyngoplasty (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; however, it is not necessarily curative for obstructive sleep apnea, because areas of the airway other than the soft palate also collapse in most patients with this sleep disorder. Furthermore, they may experience the annoying complication of nasal regurgitation of liquids following the removal of palatal tissues. A meta-analysis by Sher et al²³ has shown that there is only a 41% chance of achieving an AHI of <20 following UPPP.

Adverse effects of UPPP include: Pain, Bleeding, Risk of infection, Changes in voice frequency, Rare instances of severe scarring of the palate could potentially worsen the OSA and make speech unusually non-nasal sounding. Some patients do note a foreign body feeling when they swallow after having had a UPPP and is due to scar formation. The failure rate increases when it is performed alone in the presence of retrolingual obstruction. Response rates to UPPP decrease over time and the patient may still need to use the CPAP machine due to scar tissue.

Laser-assisted uvulopalatoplasty (LAUP)²⁴

In this non invasive surgical method, The Gallium aluminium arsenide infra red P-laser (830nm) has been used, Its highly effective in eliminating snoring problem and 65% effective in improving the apnea.

Nasal, Septal and Adenoid surgery

Nasal, Septal and Adenoid surgeries are sometimes performed for Chronically enlarged nasal turbinates, Weak or malpositioned cartilages, deviated nasal septum, enlarged adenoid that may interfere with

breathing order to open the nasal breathing passages and permit easier breathing are helpful in removing the mechanical obstruction and can facilitate the use of nasal CPAP.

Radio frequency (rf) procedure or somnoplasty²⁵

Radiofrequency Tissue Volume Reduction (RFTVR) is a surgical method which uses radiofrequency heating to create targeted coagulative submucosal lesions resulting in tissue volume reduction. The radiofrequency treatment involves piercing the tongue, throat or soft palate with a special needle (electrode) connected to a radio frequency generator. The inner tissue is then heated to 158 to 176 degrees F, in a procedure that takes approximately half an hour. The inner tissues shrink, but the outer tissues, which may contain such things as taste buds, are left intact. During the following six to eight weeks the submerged wound undergoes healing, contraction and stiffening. The intended result is relief of nasal obstruction when used to shrink the nasal turbinates, diminished snoring when used to reduce the soft palate or elimination of OSA when used for tongue reduction.

Advantage is less post-operative discomfort. The disadvantages of Somnoplasty treatment for OSA are the need for multiple treatment sessions.

Tracheostomy

A tracheostomy bypasses the site of the upper-airway obstruction. It is the most effective surgery available for OSA and has been shown to improve survival.²⁶ It is seldom performed, however, because of its complications (eg stoma and airway infection, and granuloma formation) and functional limitations (eg difficulty with speech) that require ongoing care.

MAXILLOMANDIBULAR ADVANCEMENT ²⁷

Maxillo-mandibular Advancement (MMA) or double jaw advancement is a procedure whereby the upper and lower jaws are surgically moved forward (Lefort 1 osteotomy of the maxilla & bilateral sagittal split advancement of the mandible). The concept is that as the bones are surgically advanced the soft tissues of the tongue and palate are also moved forward, again opening the upper airway. In the past 20 years, maxillomandibular advancement has been widely accepted as the most effective surgical therapy for obstructive sleep apnea syndrome. Maxillomandibular advancement has been shown to enlarge the pharyngeal and hypopharyngeal airway by physically expanding the facial skeletal framework. It has also been shown that the forward movement of the maxillomandibular complex increases soft tissue tension, prevents airway collapsibility.

CONCLUSION

Sleep medicine is obviously a challenging field, evolving with newer technologies in the diagnosis and the treatment modalities. OSA should be approached as a chronic sleep relating breathing disorder requires long term multi disciplinary management. 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.

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