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RESEARCH ARTICLE

DENTAL REHABILITATION OF OBSTRUCTIVE SLEEP APNOEA (OSA) PATIENTS- A REVIEW

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ABSTRACT

Obstructive sleep apnoea (OSA) is a severe debilitating disorder characterized by repetitive closure of upper airway during sleep and is common in adult population. OSA shows detrimental effects on health, neuropsychological development, quality-of-life, and economic potential and now it is recognized as a public health problem. Recently, American Academy of Sleep Medicine has recommended oral appliances for OSA. Hence, the therapeutic interventions that are directed at the site of airway obstruction in the maxillofacial region are within the scope of dentistry. Treatment of OSA can improve vitality, social and daytime functioning, family life and mental health of a person and hence the quality-of-life. Obesity, craniofacial abnormalities such as micrognathia and retrognathia, genetic predisposition, alcohol, smoking, and sedatives may also predispose to OSA. Treatment modalities for OSA are behaviour modification, diet and medication, CPAP devices, surgical (maxillo-mandibular advancement surgery), and oral appliances.

Key words: Obstructive sleep Apnoea, Polysomnography, Continuous positive airway pressure, Mandibular advancement devices.

INTRODUCTION

Obstructive Sleep Apnoea (OSA) is a disorder characterized by repetitive closure of the upper airway during sleep, resulting in sleep fragmentation and nocturnal oxygen desaturation, leading to daytime sleepiness and neurocognitive impairment. Long-term consequences of OSA include increased risk of cardiovascular morbidity and mortality .The estimated prevalence of OSA is 4% in men and 2% in women in the middle-aged population (Sutherland, 2011).

Who Is At Risk

Obstructive sleep apnea can develop in anyone at any age but most often occurs in people who are: Overweight, Male, age 40 and above, Smokers and with Family History.

Obstructive sleep apnea (OSA) occurs when tissues at the back of the throat collapse and momentarily block the airway. Breathing is temporarily stopped. In most cases the person is unaware of it, although sometimes they awaken and gasp for breath. In some cases, the interference is incomplete (called obstructive *hypopnea*) and causes continuous but slow and shallow breathing. In response, the throat vibrates and makes the sound of snoring. Snoring can occur whether a person breathes through the mouth or the nose. (Snoring often occurs without apnea.) Apnea decreases the amount of oxygen in the blood, and eventually this lack of oxygen triggers the lungs to suck in air. At this point, the patient may make a gasping or snorting sound but does not usually fully wake up. Obstructive sleep apnea is defined as five or more episodes of apnea or hypopnea per hour of sleep (called apnea-hypopnea index or AHI) in individuals who have excessive daytime sleepiness. Patients with 15 or more episodes of apnea or hypopnea per hour of sleep are considered to have moderate sleep apnea.

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Other Types of Apnea

Central sleep apnea is less common. It is caused by a problem in the central nervous system most often a failure of the brain to signal the airway muscles to breathe. In such cases, oxygen levels drop abruptly and usually the sleeper wakes with a start. CSA results from a centrally mediated decrease, or complete lack of, respiratory drive and is manifested by an absence of diaphragmatic and chest wall movement during sleep, i.e. no attempt is actually made to inspire (Strauss, 2012)**.** Mixed apnea is the term used when central and obstructive sleep apneas occur together. Upper airway resistance syndrome (UARS) is a condition in which patients snore, wake up frequently during the night, and have excessive daytime sleepiness. However, patients do not have the breathing abnormalities that characterize sleep apnea and they do not show a reduction in blood oxygen levels.

Etiopathogenesis

All of the muscles in the body relax during sleep. In people without obstructive sleep apnea, the throat muscles relax but do not block the airways. In patients with obstructive sleep apnea, the airways do become temporarily blocked or narrowed during sleep, reducing air pressure and preventing air from flowing normally into the lungs.

Structural abnormalities that can contribute to sleep apnea: - These include:

- Undersized or receding lower jaw or chin (micrognathia)

- Jutting lower jaw (retrognathia)
- Narrow upper jaw
- Inadequate VDO
- Enlarged tongue and tonsils
- Large neck
- Stiffer and larger soft palate.
- Abnormalities or weakness in the muscles that surround the airway
- Nasal obstruction by nasal polyps (Gassino *et al*., 2005).

Causes of Obstructive Sleep Apnea in Children

Sleep apnea occurs in about 2% of children and can occur even in very young children. The most likely causes include:

Facial or skull abnormalities in infants such as brachycephaly, a birth defect in which the head tends to be shorter or wider than average. Large tonsils, adenoids, or both in small children. (Removal of tonsils or adenoids can free the airways and may solve the problem) (Conley, 2011). Neuromuscular disorders that affect the muscles in the airways.

Medical Conditions Related to Sleep Apnea

Diabetes, *Gastroesophageal Reflux Disease (GERD) and Polycystic Ovary Syndrome (PCOS).*

Complications

Daytime Sleepiness, *High Blood Pressure*, *Coronary Artery Disease, Heart Attack, Stroke, Heart Failure and Atrial Fibrillation.*

Diagnosis

The symptoms of obstructive sleep apnea are not very specific. This means that most people who snore at night or who feel tired during the day probably do not have sleep apnea. Other medical reasons for daytime sleepiness should be considered before referral to a sleep center for diagnostic sleep tests. They include: Having to work excessive hours or varying shifts (nights, weekends). Medications (tranquilizers, sleeping pills, antihistamines and beta blockers.

Alcohol abuse

Medical conditions (such as underactive thyroid, abnormal blood sodium levels, high blood calcium levels) Self-imposed short sleep time other sleep disorders, such as narcolepsy, insomnia, or restless legs syndrome Chronic fatigue syndrome

PHYSICAL EXAMINATION

Involves examination of abnormalities in soft palate or upper airways,including enlarged tonsils and neck measurement (over 17 inches in men or 16 inches in women).

Polysomnography

Sleep testing is recommended for patients who are considered at high risk for complications of obstructive sleep apnea. These include people who are obese, and those who have heart failure, coronary artery disease, or disturbances in heart rhythm. Polysomnography is the technical term for an overnight sleep study that involves recording brain waves and other sleep-related activity.

Home Diagnostic Portable Monitors

Monitors use nasal and respiratory sensors to record airflow, respiratory effort, and blood oxygen levels.

C.B.C.T-Cone Beam Computed Tomography

CBCT allows the clinician to visualize and measure changes in airway size in 3 dimensions and configuration after both non-surgical and surgical therapy. One of the major advantages of CBCT is that its relatively low radiation dose and wide availability make it an ideal tool to evaluate the effects of therapeutic interventions (Strauss, 2012). The most common CBCT measurements used to compare the static morphology of the upper airway between OSA patients and non-OSA patients are the minimum surface area of the oropharyngeal region and the anterior-posterior and lateral dimensions of this area. The airway of a patient with OSA is smaller and is narrowed laterally (Strauss, 2012).

Figure 1- Left lateral septal mass (red arrows) taken from CBCT initially taken for evaluation of OSA.

Treatment

Today 3approaches seem to be the most effective

- Nasal continuous positive airway pressure (NCPAP).
- Use of intraoral appliance.
- Surgical techniques (Kurtulmus *et al*., 2009).

Continuous Positive Airflow Pressure (CPAP)

Since its introduction in in the 1980s, it is considered to be the primary treatment method for moderate-to-severe OSA. However, side effects associated with its usage are frequently reported and these are non compliance of the patients (Kurtulmus *et al*., 2009), mask discomfort, nasal dryness and congestion. This current gold standard treatment involves delivering positive pressure generated by a machine to the upper airway via tubing and a facial/nasal mask interface to pneumatically splint open the airway at night (Sutherland, 2011).

Medications

Modafinil (Provigil), which is also used to treat narcolepsy, was approved by the FDA as the first drug to treat the sleepiness associated with obstructive sleep apnea. Patients who take modafinil should adhere to CPAP treatment as the drug treats only the symptom of sleepiness, not the underlying obstructive sleep apnea.

(Modafinil can cause rare, but serious, side effects such as life-threatening rash) Sedatives, narcotics, antidepressants, and anti-anxiety drugs can actually worsen the breathing disturbances and arousal conditions that occur with sleep apnea. These substances cause the soft tissues in the throat to sag and diminish the body's ability to inhale. Apnea sufferers should never use sleeping pills or tranquilizers. Apnea patients undergoing surgery should be sure that their surgeons, anesthesiologists, and other doctors are aware of their sleeping disorder in considering sedatives, anesthetics, and medications taken to relieve pain due to surgery.

Intraoral Appliances

MAD [Mandibular Advancement Devices] are now recommended as a first line treatment for mild to moderate OSA, as well as in more severe patients who are unable to tolerate or refuse CPAP according to the clinical practice parameters of American Academy of Sleep Medicine (AASM) (Sutherland, 2011). Clark *et al.* (1993) recommended that MAD should be constructed to position the mandible forward by 75 per cent of the maximum range of protrusion. In a number of studies, the degree of maximal mandibular advancement has varied (Clark *et al.*, 1993; Ferguson *et al.*, 1996, 1997; Tegelberg *et al.*, 1999; Yoshida, 2000; Gavish *et al.*, 2001).

They have become popular because of their effectiveness in treating sleep disordered breathing (Bonham *et al.*, 1988; Marklund *et al.*, 1998); Wilhelmsson *et al.*, 1999). Marklund *et al.* (2001) measured the degree of mandibular repositioning on initial plaster casts made from wax construction bites and Battagel *et al.* (1999) carried out measurements on cephalograms taken while wax wafers maintained the mandible in the correct position. The anterior mandibular advancement and the vertical distance between the maxilla and mandible (bite opening) obtained with MAD have been reported in several studies (Ferguson *et al.*, 1997; Tegelberg *et al.*, 1999; Lowe, 2000; Gavish *et al.*, 2001). The most critical step in the construction of a MAD is bite registration (George, 1996). The most common bite registration material is wax in a protruded position used for orthodontic activators. This has also been used for constructing the index for MAD. The George Gauge® (GG) (George, 1992, 1996, 2001) was developed and introduced as an aid in determining the amount of protrusion needed in MAD construction (Bondemark, 1999; Lowe, 1999; Bondemark and Lindman, 2000; Gale *et al.*, 2000) (Fransson *et al*., 2003). Based on the reduction of baseline AHI (Apnoea / Hypoapnoea Index) and ODI (Oxygen Desaturation Index) to 10 or less, the MAD success rate is 33 and 35 per cent respectively (Jhonston *et al*., 2002). It is concluded that the success rate, defined as the ability of oral appliances to reduce sleep AHI to less than 10, is 54%. Snoring was reduced by 45% (Manhony, 2012).

Mechanism of Action Dental Devices

Mandibular advancement device with plates that attach to the upper and lower dental arches. With this device the level of mandibular advancement is adjusted via the lateral screws on the upper plate. The acrylic extensions on the lower plate provide the coupling to the upper plate to maintain the jaw in theprotruded position (Sutherland, 2011). In OSA collapsing forces on the upper airway result in complete or partial upper airway obstruction.

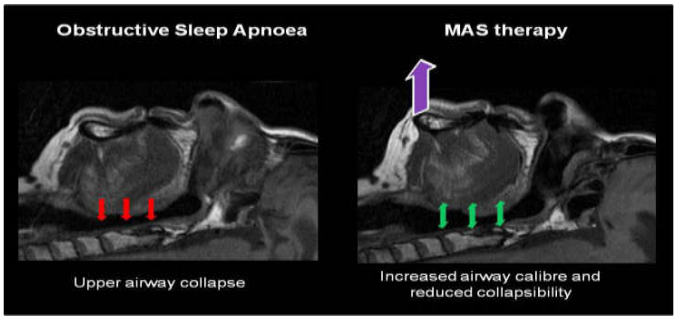

Figure 2- Mechanism of action of mandibular advancement splints therapy

MAD worn during sleep hold the mandible and tongue in a protruded position resulting in an increase in upper airway calibre and a reduction in the propensity to collapse (Sutherland, 2011).

Mandibular advancement device (MAD)-This is the most widely used dental device for sleep apnea. It is similar in appearance to a sports mouth guard. The use of this functional prosthesis counteracts the condition causing OSA, via elevation of the base of the tongue, increased palatoglossus muscle tone, soft palate protrusion, pharynx expansion and standardization and stabilization of pharyngeal walls (Manhony, 2012).

Figure 3. Mandibular advancement device

Indications:-Mild to moderate Obstructive Sleep Apnoea Severe Obstructive Sleep Apnoea with refusal or intolerance of CPAP Good dental health with <10 teeth per dental arch.

Contraindications

- Central Sleep Apnoea
- Severe symptomatic OSA requiring immediate treatment (e.g. Sleepy drivers,
- severe hypoxemia)
- Exaggerated gag reflex
- Temporomandibular jaw problems
- Periodontal disease
- Insufficient teeth to support the device
- Limited maximum protrusive distance <6mm (Ogawa *et al*., 2011)

Benefits of dental device:- Significant reduction in apneas for those with mild-to-moderate apnea, particularly if patients sleep either on their backs or stomachs. They do not work as well if patients lie on their side. The device can also be used to treat moderate to severe OSA patients who refuse to take CPAP therapy (Giannasi *et al*., 2013). Improvement in sleep in many patients (Manhony, 2012).

MAD activates the master and submental muscles during sleep and prevents the upper airway from collapsing (Kurtulmus *et al*., 2009). Improvement and reduction in the frequency of snoring and loudness of snoring in most (but not all) patients (Manhony, 2012). Few or no complications (Sutherland, 2011). Oral appliance therapy for OSAS patient with hypertension can lead to substantial reduction in day time blood pressure (Yoshida , 2006). MAD therapy decreased the AHI (Apnoea/ Hypoapnoea Index) scores of a patient with Facial Paralysis (Piskin *et al*., 2012).

Side-Effects

Short-term side-effects are Mouh dryness, salivation, gum irritation, dental discomfort, temporomandibular joint pain.
Long-term side-effects are Occlusal changes, increased facial height, increased mouth opening, increased mandibular plane angle, changes in the inclination of incisors (Sutherland, 2011).

Fabrication of mandibular advancement device

Anatomic impressions are made with irreversible hydrocolloid impression material and functional impressions are made with condensation silicone material. The master models are cast with dental stone. Maxillary and mandibular occlusal splints are fabricated on master models with autopolymerising acrylic resin. Splints are prepared such as to cover occlusal and incisal surfaces of the dentition for prevention, to minimise the orthodontic side effects of MAD and to provide comfortable usage combined with satisfactory retention and stabilization during sleep (Piskin *et al*., 2012). The MAS appliance should be fabricated with a 75% to 80% protrusion and a 5-7mm vertical dimension and anterior airway (Kurtulmus *et al*., 2009) **.**The physiologic vertical dimension recorded should be mounted on an articulator. Intermaxillary relationships are determined following the fabrication of splints (Piskin *et al*., 2012).

Figure 4. Mandibular advancement device should be fabricated with a 75% to 80% protrusion and a 5-7mm vertical dimension and anterior airway

The most common dimensions that are described protrude the mandible by 5–7 mm (50–75%) Clark and Nakono, 1989; Johal, 1998; Lyons *et al*, 2001; Lowe, 2002) (Patrick, 2012). Autopolymerising acrylic resin should be applied to fix maxillary and mandibular occlusal splints from first premolar up to second molar teeth bilaterally. After the MAD is completed, it is inserted into the mouth with minor adjustments (Piskin *et al*., 2012). Patient are advised to wear the appliance for atleast 6 hours during the night and recalled for any necessary adjustment 1 day later (Kurtulmus *et al*., 2009).

Orthodontic Treatments

An orthodontic treatment called rapid maxillary expansion, in which screw device is temporarily applied to the upper teeth and tightened regularly, may help patients with sleep apnea and a narrow upper jaw. This nonsurgical procedure helps to reduce nasal pressure and improve breathing (Sutherland, 2011).

Surgery

The American Sleep Disorders Association (ASDA) which has been renamed the American Association of Sleep Medicine (AASM) describes eight surgical treatment options and five conservative treatment options for the patient with OSA (Sutherland, 2011).

Surgical interventions	**Conservative interventions**
Tracheostomy	Weight loss
Uvulopalatopharyngeoplasty (UPPP)	Alcohol cessation
Epig lottoplasty	Altering sleep position Oral appliance CPAP

- Tonsillectomy and Adenoidectomy (T & A)
- Genial advancement (with or without hyoid myotomy)
- Laser glossectomy and lingualplasty
- Maxillomandibular advancement (MMA)
- Site specific excision (Sutherland, 2011).

Other Procedures

- Radiofrequency ablation (RFA) for tongue or palate reduction.
- Hyoid advancement surgery, in which the movable bone underneath the chin is moved forward, pulling the tongue muscle along with it.
- Surgery for nasal obstructions (such as a deviated septum) that contribute to snoring and other symptoms.
- Removing Adenoids and Tonsils in Children.
- Use of chest implant- A pacemaker delivers electrical impulses to a nerve that controls the tongue and maintains the muscle tone of a sleeping person's upper airway, according to a study published in the Jan. 9 issue of the *New England Journal of Medicine* (Thomson, 2014).

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