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## RESEARCH ARTICLE

### OBSTRUCTIVE SLEEP APNEA AND ORTHODONTICS - A REVIEW

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#### ABSTRACT

Sleep apnea is a serious sleep disorder that occurs when a person's breathing is interrupted during sleep. There are basically two types of Sleep apnea (central sleep apnea and obstructive sleep apnea) where obstructive sleep apnea is the more common one. OSA is associated with interrupted breathing during sleep due to any obstruction due to repeated collapse of airway. This disorder can be life threatening as the oxygen supply to various parts of the body is substantially reduced. This review article sheds light on the various diagnostic methods and the management of OSA which includes the specific and non-specific treatment modalities. The various surgical methods and oral appliances are also looked upon for the management of OSA.

## INTRODUCTION

The word apnea is derived from the Greek word which means "without breath". Sleep apnea, is a sleep disorder characterized by pauses in breathing or cessation of breathing during sleep. Obstructive sleep apnea is one among the three variants of sleep apnoea condition which is characterised by repetitive episodes of upper airway obstruction that occur during sleep, usually associated with a reduction in blood oxygen saturation (Richardson *et al.*, 2007). In 1918 Sir William Osler coined the term "Pickwickian" to refer to obese, hypersomnolent patients. The name originated from the character of a fat boy named Joe, depicted in the novel by Charles Dickens's "The Posthumous papers of the Pickwick club", who was markedly obese and tended to fall asleep uncontrollably during the day. In 1956 Dr. Burwell and colleagues found similar symptoms of Joe in a patient whom they were treating and termed it as the "Pickwickian Syndrome" which is currently known as obstructive sleep apnoea.

### Types of apnea

**Obstructive Apnea:** Obstructive sleep apnea is characterized by the cessation of airflow with persistence of ventilatory effort, caused by collapse of soft tissue structures in the oropharynx or hypopharynx.

**Central Apnea:** Central sleep apnea (CSA) occurs when the brain temporarily fails to signal the muscles responsible for controlling breathing. Unlike obstructive sleep apnea, which can be thought of as a mechanical problem, central sleep apnea is more of a communication problem

**Mixed apnea:** Mixed sleep apnea is a combination of both obstructive and central sleep apnea symptoms.

### Obstructive sleep Apnoea

Symptoms (Pathophysiology of adult obstructive sleep apnea danny, 2008)

- Excessive daytime sleepiness, frequent episodes of obstructed breathing during sleep.
- Loud snoring
- Morning headaches
- Dry mouth upon awakening
- Chest retraction during sleep in children(chest pulls in)
- High blood pressure
- Overweight
- Irritability
- Change in personality
- Depression
- Heartburn
- Nocturia

Etiological Factors (Young *et al.*, 2004)

- Older individuals exhibit greater pharyngeal resistance
- Men are at greater risk for OSA
- Obesity correlates significantly with pharyngeal resistance
- Drugs - increases the degree of relaxation of the upper airway muscles and interfere with the brain's arousability

- Alcohol
  - Sedative drugs (eg. benzodiazepines - valium, ativan)
  - Sleeping pills
  - Anaesthetics
  - Narcotics (codeine, morphine)
- Smoking, which can cause swelling of the upper airway
  - Genetic element
  - Retropositioned maxilla and mandible
  - Enlarged tonsils and adenoids, the main causes of OSA in children
  - Nasal congestion
  - Menopause –due to hormonal fluctuations
  - Diabetes
  - Supine position
  - Hypothyroidism, acromegaly, amyloidosis, vocal cord paralysis, Marfan's syndrome, and Down syndrome

### Pathogenesis

During inspiration the stability and patency of the upper airway are dependent upon the action of oropharyngeal dilator and abductor muscles, which are normally activated in a rhythmical fashion. When the force produced by these muscles exceeds the negative airway pressure generated by inspiratory activity of the diaphragm and intercostal muscles, the upper airway collapses.

### Possible Sites of Obstruction (Mallampati *et al.*, 1985)

#### Nose:

- Deviated septum
- Enlarged turbinates
- Polyps

#### Nasopharynx:

- Enlarged adenoids

#### Pharynx:

- Enlarged tonsils
- Enlarged uvula or soft palate
- Enlarged base of the tongue
- Tongue base falling into pharyngeal airway
- Submucosal fat or redundant mucosa

### RDI Index

The American Academy of Sleep Medicine (AASM) rates the average number of obstructive sleep apnea events per hour as Respiratory Distress Index (RDI) (Farney *et al.*, 2011).

Table 1.

RDI	Grade
0-5	Normal
5-20	Mild
20-40	Moderate
>40	severe

### Diagnosis

**Physical examination:** It includes the examination of respiratory, cardiovascular and nervous system. Obesity is one of the most significant findings in patients with OSA hence

assessment of the Body Mass Index (above 30 kg/m<sup>2</sup> is a risk factor for OSA) and the neck circumference (above 17 inches in men, or 16 inches in women is a risk factor for OSA) is of utmost importance.

**Oral examination:** The upper airway should be examined in all patients, particularly in nonobese adults who exhibit symptoms consistent with those of OSA. Mallampati scores (Mallampati *et al.*, 1985) used in anesthesia for determining the difficulty of performing an intubation as the tongue obstructs the airway is used to evaluate OSA (Mallampati scores of 3 and 4 exhibit greater risk of sleep apnea). Intraorally the patient should also be examined for micrognathia, lateral peritonsillar narrowing, macroglossia, tonsillar hypertrophy, elongated or enlarged uvula, high arched or narrow palate, nasal septal deviation, and nasal polyps

### Investigations

- Polysomnography -It is considered the gold standard of sleep apnea diagnosis (Farney *et al.*, 2011). A sleep technician administers the study. Sleep polysomnography features electrocardiography/EKG, brainwave electroencephalography/ EEG measurements, motor activity extremity measurements, diaphragmatic/chest movement, eye movement, pulse oximetry for oxygen desaturation measurement, and inhalational/ exhalational oro-nasal flow characteristics

Criteria include:

- Cessation of air flow for 10 seconds even with maintenance of respiratory effort.
- Five or more episodes of apnea per hour.
- Decrease in oxygen saturation of at least 4% during episodes.

- Radiographs - Radiographic studies that have been found to be useful include lateral neck films that can demonstrate adenotonsillar hypertrophy and some other airway lesions. The significant advantages of cephalometry are its easy access, low cost, and minimal radiation. The exposure should be taken at the end of the expiration

#### ➤ Cephalometric characteristics of osa(alan lowe)

- Mandibular retrognathia
- Retruded maxilla
- Posterior vertical maxillary deficiency
- Retropositioned tongue
- High mandibular plane angulation
- Short chin-neck line
- Poor definition of gonial angles
- Class II dental occlusion (but sometimes Class I)
- Longer soft palate

- **Visualisation of upperairway:** Rigid bronchoscopy and laryngoscopy under general anesthesia may be necessary in children where the site of obstruction cannot be determined by physical examination or radiographic studies.

- **EMG activity:** Genioglossus (Wheatley *et al.*, 1993) - Patients suffering from OSA usually have an increased

tongue size with an altered shape. These patients when move to a supine position from an upright posture cause the tongue to fall backwards and result in the blockage of the airway. When the patient is asleep, the movement of the tongue is reduced and this reduction of the tone leads to the thickening of the muscle and might also cause backward positioning of the tongue. Pharyngeal wall (Kuna *et al.*, 1997) - A study done by Kuna et al evaluated the pharyngeal constrictor muscles of normal adults during their wakefulness and sleep. The electromyographic activity of these muscles were checked upon and was concluded that there was a decreased electromyographic activity of these muscles which indicates a decreased tone of the same

- Oximetry-Overnight oximetry helps in assessing abnormal drops in oxygen level which occur recurrently in sleep apnoea. OSA is often associated with periodic pauses in breathing and drops in the oxygen level of the blood. Overnight oximetry is an easy and inexpensive method of screening test which helps in assessing abnormal drops in oxygen level
- Multiple sleep latency test - The Multiple Sleep Latency Test (MSLT) is an examination to test how quickly a person falls asleep during the daytime. It consists of 4-5 naps of 20 minutes duration, at every 2 hours interval during the day. On an average. An adult requires a mean sleep latency period of 10minutes or more. Individuals who exhibit excessive day time sleepiness show a mean latency period of less than 5 minutes

### Treatment options

The treatment options for OSA could be broadly classified into Non specific and specific therapy. Before considering the therapy for the patient a thorough diagnosis is required to find the causative agent. There are various factors to be assessed before selecting the treatment modalities for a specific individual. These include:

- The severity of the disease
- The obstruction site
- Subjective symptoms
- Patient preference
- ❖ Nonspecific therapy: As the name suggests nonspecific, these treatment methods should be advised for all the patients suffering from OSA no matter what the severity but it is most notably used for patients whose chief concern is the snoring with a mild apnea.
- ❖ Specific therapy: Specific therapy on the other hand is tailored to the individual patients need based on medical history, physical examination, and the results obtained from polysomnography.
- *Oxygen administration* – Not commonly used alone but when used in combination with nasal continuous positive airway pressure it corrects this problem. It's usually used in central apnea which is caused by heart failure rather than in patients with obstructive sleep apnea.
- *Positive pressure therapy* - This is one of the most effective treatment therapy for OSA. It includes:

- Continuous positive airway pressure (CPAP)
- Autotitration
- Bi-level positive airway pressure

**Continuous positive airway pressure (CPAP):** CPAP is usually administered by a facial mask which is held in position around the patients head (Becker *et al.*, 2019). This technique uses the positive pressure which is passed by a small air compressor into the mask through the tubes into the upper airway. This maintains the patency of the airway throughout the sleep. The amount of pressure varies in every individual and a polysomnogram must be used to assess the patient.

**Autotitration:** These are devices which are designed such that they provide the minimally required pressure at a certain period and also change the pressure as the patients requirements change.

**Bi-level positive airway pressure:** This is similar to CPAP but has an advantage over it as it is designed such that it automatically detects the patients breathing pattern and modify the pressure on inhalation and exhalation.

➤ *Pharmacological agents:* Various pharmacological agents may also be used but are said to be not very useful for the treatment of sleep apnea. These include:

- Thyroid hormone supplementation
- Progestational agents like estrogen
- Acetazolamide
- Tricyclic antidepressants
- Modafinil

➤ *Surgery-* Even with all the pain and the cost of treatment sometimes surgery might be the only option. They usually have a relatively poor long term success rate. Some of the surgeries which may be carried out to treat OSA include:

- Nasal, septal and adenoid surgery
- Tonsillectomy
- Genioglossus tongue advancement
- Uvulopalatopharyngoplasty
- Laser-assisted uvulopalatoplasty
- Maxillomandibular advancement
- Radio frequency (RF) procedure or somnoplasty
- Hyoid suspension
- Tracheostomy

### Oral appliances

Oral appliances may improve upper airway patency during sleep by enlarging the upper airway and/or by decreasing upper airway collapsibility (e.g., improving upper airway muscle tone) (Ferguson *et al.*, 2016). The appliance may include tongue repositioning devices, such as the tongue retaining device, a mandibular advancement device which works by advancing and restricting the lower jaw and the tongue in a forward position during sleep and devices which are designed to elevate the soft palate or reposition the uvula.

#### •Tongue Retaining Devices

The Tongue Retaining Device was first developed in 1979. It is made of soft polyvinyl. This bubble shaped appliance has

custom fitted grooves in which the patient's teeth rest while the tongue rests within the bubble. The bubble forms a suction that holds onto the tongue in a more anterior position and hence any obstruction due to the base of the tongue is avoided.

#### •Oral Airway Dilator Designs

- *The Silencer System*: This appliance incorporates the Halstrom Hinge Titanium Precision Attachment at the incisor level, it permits 2 mm advancement up to 8mm, a lateral movement of 6 mm, 3 mm bilaterally, and vertical pin height replacements. A flat posterior bite plane is provided for the biting surfaces. This appliance cannot be adjusted by the patient, but must be adjusted in the dental office. It is made of elastomeric plastic and is the only appliance that allows adjustment in not only a front to back' position, but also in an 'open and close' position. It is one of the most expensive appliance due to the presence of the titanium hinge.
- *The Klearway oral appliance*: This appliance is fabricated using a thermoactive acrylic, it becomes pliable for easy insertion and confirms securely to the dentition for an excellent fit while significantly decreasing soft tissue and tooth discomfort. It utilizes a maxillary expander to sequential advancement of the mandible. Klearway is a fully-adjustable oral appliance used for the correction of mild to moderate Obstructive Sleep Apnea and snoring. Some amount of jaw movements, i.e., in the vertical and lateral direction is permitted without dislodging the appliance.
- *The PM Positioner*: It contains bilateral orthodontic expanders which links upper and lower, has attachment connectors on both lateral sides (Lilian *et al.*, 2008). 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. This appliance is bound firmly on the buccal side of the molar teeth and restricts the mandible once worn.
- *The Elastic Mandibular Advancement (EMA)*: Compared to the other appliances the EMA appliance is the least bulkiest and gives about significant amount of freedom for the jaw movements (Henke *et al.*, 2000). It is not very patient friendly and may be difficult to tolerate.
- *Mandible repositioning device*: It likely has a role as a first-line therapy for the treatment of mild and moderate OSA patients and as a second-line therapy for severe patients (Stuart *et al.*, 1996).

#### Conclusion

As orthodontists we play a significant role in the diagnosis of sleep apnea and we should aim at addressing the individual immediately once diagnosed as Sleep-breathing disorders are potentially life threatening; therefore, the right diagnosis and treatment of these diseases becomes very crucial. Various factors should be kept in mind while formulating the treatment

plan and the oral appliance for its correction as it might differ from person to person

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