OBSTRUCTIVE SLEEP APNEA - AN ORTHODONTIST’S PERSPECTIVE

Mahalakshmi K¹, Sumanth Rangarajan², Balaji K³, Job Jacob Anison⁴, Sunil Chandy Varghese¹

Abstract:
Obstructive sleep apnea is a serious breathing disorder caused due to obstruction of airway or due to the morphological variations in the airway. It is characterized by snoring, daytime sleepiness, dizziness with extra oral features such as retrognathic mandible, steep occlusal plane. It might sometimes lead to deterioration of systemic health leading to hypertension, angina etc. This paper deals with causative factors, features and different modality of treatment of obstructive sleep apnea.

Key words: Obstructive sleep apnea, Airway, CPAP, Oral appliance

1. Senior Lecturer, Department of Orthodontics, Tagore Dental College, Chennai.
2. Reader, Department of Orthodontics, Sri Venkateshwara Dental College, Chennai.
3. Head, Department of Orthodontics, Tagore Dental College, Chennai.
4. Reader, Department of Orthodontics, Tagore Dental College, Chennai.

Introduction
Obstructive sleep apnea (OSA) is a disorder in which periodic nocturnal breathing cessation occurs during sleep. When breathing ceases for more than ten seconds, it is termed as apnea. When these episodes are more than thirty, they are called as sleep apnea syndrome.¹ Obstructive sleep apnea was first demonstrated by Guilleminault et al in 1976.² Broadbent (1877) stated that in OSA periodic silence during inspiration occurs due to the decreased chest movements which is followed by a loud snort with several deep inspiratory movements.

Obstructive sleep apnea has more predilection in men than in women. Banabilha in his study has stated that men have dense bone with more fat deposition leading to the increased susceptibility of collapse of the upper airway.³ The incidence of Obstructive sleep apnea also increases with age. Bixler stated that the middle age group (45-64 yr) has the maximum prevalence compared with young and old age group. He also stated that there is genetic predilection in OSA.⁴

Sleep apnea affects both the quality and the duration of life. The more severe form of OSA may lead to several disorders such as hypertension, nocturnal angina, cardiac arrhythmia, myocardial ischemia sometimes leading to death. In this article we discuss about the various features and the different treatment modality of Obstructive sleep apnea.

Obstructive sleep apnea (OSA) is caused by obstruction of upper respiratory tract during sleep. OSA can be broadly classified into three types according to the area it involves. They are obstructive where the obstruction of upper airway occurs without any changes in thoracic breathing movements, central in which both the upper airway and thoracic movements are affected and mixed where central apnea occurs for 10 sec followed by obstructive sleep apnea.¹
Pathophysiology:

In OSA the tonicity of the muscles and the airway morphology plays an important role in apneic episodes. In normal conditions, the patency of upper airway is maintained by the action of pharyngeal and abductor muscles. During sleep, as the inspiratory volume and ventilation decreases the resistance of upper airway increases leading to increased arterial Carbon di oxide tension. In obstructive sleep apnea the inspiratory muscles in upper airway has a dilatory effect and the thoracic muscle negative intra airway pressure causing collapse of upper airway.

Leiter et al studied the role of airway shape in OSA patients and found that airway with more antero posterior diameter has increased risk of collapsibility. He also stated that the muscles on the anterior border of pharynx determines the volume and the shape of the airway while the lack of muscles on the lateral border leads to collapse in OSA patients. The deposition of fat pads also leads to the increased constriction of the airway. The most dorsal point of the soft palate is determined as the most narrow diameter due to the extended head posture leading to the increased cranio cervical angle decreasing the obstruction caused in the airway.

Clinical Features:

Many predisposing factors may increase the rate of occurrence of OSA. Factors such as obesity, increased BMI, alcohol ingestion which decreases the output of hypoglossal nerve and pharyngeal length may lead to sleep apnea. Deposition of fat in the soft palate, tongue and pharynx along with increased BMI of 27.8 kg/m² in men and 27.3kg/m² in women leads to increased susceptibility of OSA. Alcohol ingestion may lead to decrease in activity of hypoglossal nerve output.

The orofacial characteristics of obstructive sleep apnea includes retrognathic mandible large neck circumference of more than 17 inches for men and 15.5 inches for women, nasal septal deviation with increased susceptibility of sinusitis, otis media, infection and in severe cases pulmonary hypertension etc may be seen. Intr orally these patients exhibit narrow palate, tonsillar hypertrophy, macroglossia, extrusion of maxillary and mandibular teeth, bimaxillary protrusion, open bite, posterior position of posterior wall of pharynx etc.

Cephalometric features include steep occlusal plane angle, retrognathic mandible ,large gonial angle, high mandibular plane, obtuse palatal angle, decreased palatal width, short soft palate -posterior pharyngeal wall distance of less than 5mm (Fig 1) etc.

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Other features includes snoring, drooling of saliva, xerostomia, gasping, daytime sleepiness, impaired concentration, depression, irritability, gastro esophageal reflux disease etc. According to Timogrowth hormone play an important role in the determination of mandibular length. He hypothesized that patients undergoing adenotonsillectomy showed increased ramal growth due to sudden acceleration in endochondral bone formation of condylar cartilage and also by appositional growth in the base of the mandible.
Fig 1

A- Upper pharyngeal width measured from soft palate to posterior pharyngeal wall

B- Lower pharyngeal width is measured from the intersection of the posterior border of the tongue and the inferior border of the mandible to the closest point on the posterior pharyngeal wall

Investigation:

Polysomnographic test is the gold standard proposed by Holland et al in 1974 for diagnosing obstructive sleep apnea. Various stages of sleep is assessed by electroencephalograph, electromyograph, electrooculograph etc for minimum of 6 hours. Polysomnography is based on the Apnea Hyponea index and desaturation level of oxygen using pulse oximetry. Pulse Oximetry can also be used to evaluate the prognosis after surgery in Obstructive Sleep Apnea. When the AHI score is between 5 and 15 events per hour, OSA severity is very mild. If the events is more than 15-30 or more than 30 it is classified as moderate and severe sleep apnea respectively. Similarly if the oxygen saturation level is 85% - 90%, it is termed as mild OSA. If it decreases to 80% -84%, severity of sleep apnea is moderate. More severe cases of sleep apnea shows oxygen saturation below 80%. Respiratory effort of the patient is monitored using plethysmography.

Investigation:

The Mallampati Score is also used to determine the severity of obstruction of airway by tongue. It is performed with the patient in seated in upright position with jaw wide opened and tongue protruded. It is classified into four classes.

- Class I- soft palate, uvula, fauces, pillars visible.
- Class II- soft palate, uvula, fauces visible.
- Class III- soft palate, base of uvula visible.
- Class IV- only hard palate visible.

The size of the tonsil, nasal turbinates are also examined to evaluate the contribution in nasal airway obstruction. Temporomandibular Joint is also assessed before planning for the oral appliance which might lead to the jaw discomfort and TMJ problems. Split Night Studies are done to establish optimal pressure to control sleep apnea. Continuous Positive Airway Pressure (CPAP) is given and titrated for about 2 hour until the snoring episodes is eliminated.

Croft and Pringle (1991) introduced a technique called sleep nasendoscopy, where the patients are induced mild sleep pharmacologically and the upper airway is visualized using fibre optic endoscope. Level of airway obstruction was classified as palatal, tongue based or multi-level. The following grouping system was applied:

1. Grade 1: Palatal level snoring
2. Grade 2: Palatal level obstruction
3. Grade 3: Multi-segmental involvement – intermittent oro and hypopharyngeal collapse
4. Grade 4: Sustained multi-level collapse
5. Grade 5: Tongue base obstruction.
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Treatment Options:
Obstructive sleep apnea can be treated either by surgical or non surgical methods depending on the severity of the obstruction as diagnosed by the polysomnogram and symptoms of the patient. Various non surgical methods includes continuous positive airway pressure, medications, diet modifications and oral appliances like tongue retaining device, mandibular advancement appliances etc. The surgical options include adenotonsillectomy, orthognathic surgery for advancement of mandible or maxilla mandibular advancement, surgical methods include: adenotonsillectomy, uvulopalato pharyngoplasty, mandibular advancement, maxilla-mandibular advancement, distraction osteogenesis.

Tonsillectomy is one of the treatment protocol for children suffering from enlarged tonsils. Many authors have reported that after tonsillectomy patients have noticed reduction in symptoms such as snoring, enuresis, obesity etc. It might also lead to improvement in nasal breathing, decreased extension of head resulting in accelerated mandibular growth and decreased mandibular palne angle.

**CPAP:**
Continuous positive airway pressure is a gold standard for managing OSA. It is usually wearing a overnight mask which exerts pressure on the upper airway. It is used in mild to moderate sleep apnea cases and incases where the outcome of tonsillectomy is not satisfactory. The main disadvantage of CPAP includes facial ulcerations, nasal dryness and claustrophobia.

**Oral Appliance:**
American Academy of Sleep Medicine have indicated the use of oral appliances in mild to moderate sleep apnea or when the CPAP has failed. Oral appliances such as tongue retaining devices, mandibular advancement devices are used to treat OSA. The tongue retaining devices is constructed to maintain the forward position of the tongue by placing it in an anterior bulb between the anterior teeth. The forward pull of the tongue increases the upper airway volume and decreases the resistance of the upper airway and the activity of the genioglossus muscle. Mandibular advancement devices such as Herbst appliance, modified monobloc, modified Harvold monobloc, silensor appliance (fig 2) can be used for treating obstructive sleep apnea. These appliances hold the mandible in a forward position, thus enlargement of oropharyngeal space occurs with the forward repositioning of the tongue and genioglossal muscle.
Fig 2: Silensor Appliance

(Courtesy: Am J OrthodDentofacialOrthop2015;147:559-65)

Many studies have been done to find the outcome of the mandibular advancement appliances and found that patients using oral appliance had a increased mandibular plane, retroclined maxillary incisors and proclined mandibular incisors with reduced overjet and overbite, mesial movement of mandibularmolar and distal movement of maxillary molar, increased maxillary inter canine width by 0.28mm and inter molar distance by 0.46mm was also seen. Cephalometrically increased ANB angle, decreased SNB angle with no change in the mandibular length is seen.25,26,27,28

Horiuchia in his study found that good responders had a significant reduction of AHI score by 50% with low molar height in patients using oral appliance and monobloc appliance was superior to the herbst appliance in relieving symptoms.22,29 Bernhold has modified the acrylic splint by incorporating four neodymium-iron-boron magnets which produced a backward and downward movement of the mandible, increased pharyngeal airway space and decreased contact between soft plate and the tongue without any significant change in the position of the hyoid bone.30 (fig3)

Fig 3: Magnetic appliance for OSA


Eventhough the mandibular advancement appliance has many advantages, it cause stenderness of temperomandibular joint, difficulty in occlusion, increased inter incisalangle, dryness of lips and throat, hypersalivation, etc.31,32,33

Surgery:

Surgical procedures are done in cases of OSA to increase or stabilize the upper airway.34 Jacobson has stated that surgery is indicated in cases where AHI score is greater than 5, intolerance to CPAP or oral appliance etc.35 Surgeries such as uvulo palate pharyngo plasty, tracheostomy are sometimes used as an adjunctive to maxilla mandibular advancement surgery. Maxillo mandibular advancement (MMA) is done for the expansion of the skeletal framework of the face in maxilla mandibular deficiency. Won has stated that maxillary impaction with mandibular advancement can be done instead of maxilla mandibular advancement in Class II skeletal cases with orthognathic maxilla and acute nasolabial angle.36 Conley has indicated a 2 stage surgical procedure which includes maxillary and mandibular distraction osteogenesis followed by advancement of maxilla and mandible in cases of transverse and antero posterior hypoplasia.37 Distractionosteogenesis produces an expansion
of 12mm than Lefort 1 surgery where only 7mm of expansion can be done. Distraction osteogenesis is mostly used in patient with congenital anomalies. Distraction osteogenesis has an advantage of soft tissue adaptation with extensive lengthening of bone. It causes enlargement of upper airway diameter but has an disadvantage of causing ankylosis of TMJ and resorption of condyle.

Conclusion
Obstructive sleep apnea is a life threatening disorder which affects mainly the middle age, obese person with a male predilection. Even though mandibular advancement devices are used due to high compliance rate, regular medical reviews are necessary to monitor the improvement in condition of these patients. Thus, there can be no doubt that Orthodontist has a vital role to play in identifying as well as treating OSA patients.
References


Address of correspondence
Dr. Mahalakshmi K MDS, Senior Lecturer, Department of Orthodontics, Tagore Dental College, Chennai. E-mail Id: mahakrishnasai@gmail.com