European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 7, Issue 4, 2020

TITLE OF THE ARTICLE
OBSTRUCTIVE SLEEP APNEA – A REVIEW

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TYPE OF THE ARTICLE – REVIEW
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SOURCE OF FUNDING : self
CONFLICT OF INTEREST : nil

OBSTRUCTIVE SLEEP APNEA – A REVIEW

ABSTRACT
Obstructive sleep apnea is the most common sleep related breathing disorder that is characterized by recurrent episodes of complete or partial obstruction of airway leading to reduced or absent breathing during sleep. Most common trigger factors are obesity, anatomical defects in the pharynx and reduction in airway which disrupts routine sleep cycle and results in reduced quality of life. This review article describes the sequalae of events due to OSA and importance in the diagnosis and management of OSA by orthodontists.

KEYWORDS : OSA, Obstructive sleep apnea, hypopnea, adenoid, mandibular advancement, airway

1. INTRODUCTION

OSA is a common sleep related breathing disorder which requires a multidisciplinary approach including pulmonologist, otorhinolaryngologist, nutritionist, orthodontist, maxillofacial surgeon and bariatric surgeon. Orthodontist can aid in diagnosing and screening patients with OSA. Once diagnosed, the patients can b referred to their physician for further evaluation and definitive diagnosis. A thorough investigation through clinical questionnaires, cephalometric findings and additional diagnostic imaging aids in assessing OSA. Airway improvement can be achieved through the use of Maxillary protraction (if there is an existing retruded maxilla) or Mandibular advancement techniques (for retruded mandible) and maxillomandibular surgical techniques in patients with severe OSA. OSA if left untreated, will lead to other medical complications like Cardiac problems, stroke, high blood pressure, increased insulin resistance, impotence, lack of sexdrive, memory problems ,etc.

According to Young et Al, atleast 5 apneas and 5 hypopneas per hour of sleep with excessive daytime somnolence, with a prevalence of 4% in men and 2% in women between the ages of 30 to 60 years. Apnea is the complete cessation of breathing due to obstruction while hypopnea is partial or shallow breathing due to obstruction.

2. SITE OF OBSTRUCTION :

As the name says, OSA involves an obstruction which disrupts sleep due to occurrence of either apnes or hypopnea. There are two types of sleep pattern namely the Rapid Eye Movement(REM) and Non-Rapid Eye Movement(NREM). NREM predominates with 75% of sleep and is characterised by no eye movement with regular respiration and heart rate, while REM constitutes 25% of sleep cycle and is characterized by irregular respiration and heart rate and resembles wakefulness. Patients with OSA have more of apnea during the REM phase that results in disturbed sleep pattern characterised by hypopnea or apnea. Apnea can broadly be categorised to Central Apnea (there is disruption in the ventilator support) or Obstructive (Presence of obstruction in upper airway).

Thus, the site of obstruction can be:

SITE	ETIOLOGY
NOSE	Deviated nasal septum, Nasal Polyps, Enlarged Adenoids
NASOPHARYNX	Enlarged Adenoids
PHARYNX	Enlarged tonsils, Enlarged Uvula/Palate, Enlarged base of tongue
LARYNX	Laryngopharyngeal reflux changes with posterior commisural swelling
MAIN SITE	Retroglossal and retropalatal tissue

3. TYPES OF OSA

Severity of OSA can be measured by several methods.

AHI (Apnea–Hyponea Index) : This index represents combined number of Apneas and Hypopneas that occur per hour of sleep. Depending on the occurrence, it can be mild (AHI – 5-15); moderate (AHI 15-30) or severe (AHI >30)

TYPE	AHI RANGE	INTERPRETATION
MILD	5 – 15	Involuntary sleepiness during activities that require minimal attention (such as watching TV, reading)
MODERATE	15 – 30	Involuntary sleepiness during activities that require some attention (meetings/ presentation)
SEVERE	>30	Involuntary sleepiness during activities that require more attention (talking / driving)

4. PATHOPHYSIOLOGY

During wakefulness, patients with OSA appear to compensate for an anatomically compromised upper airway through protective reflexes which increase upper airway dilator muscle activity to maintain airway patency. During sleep, this muscle tonicity and reflexes that protect the pharynx from collapsing is reduced, thus predisposing to increased frequencies of apnea and hypopnea during sleep. Either during complete obstruction (apnea) less than 20% for 10 seconds or Partial obstruction (hypopnea) greater than 30% or more results in fall in blood oxygen saturation (characterized by gasping for breath) which results in disturbance in sleep.

The sequalae for patients with OSA is an increase in breathing effort (decreased PO_2 and increased PCO_2) causes arousal from sleep (due to increased UA dilator muscle activity which causes rapid UA reopening) and results in hyperventilation. The boy compensates by reducing PCO_2 and increasing PO_2. After this phase the patient returns to sleep with next phase of hypoventilation that causes UA narrowing or collapse that increases surface forces and OSA phase repeats again.

5. RISK FACTORS

It includes patients who are over weight (BMI- 25-29.9) or Obese (BMI > 30), large neck size , for men (greater than 17 inches) and for women (circumference greater than 16 inches), children with enlarged tonsils and adenoids, endocrine disorders commonly acromegaly or hypothyroidism, smokers, drugs such as sedatives, nocturnal stuffiness due to abnormal morphology or rhinitis.

6. CLINICAL PRESENTATION

There are variations in the clinical features between adults and children.
In adults, there is sleeplessness during nights, physically restless sleep and insomnia, morning dry mouth or sore throat as a result of mouth breathing, morning headache and confusion (due to increased CO2 levels) and night sweats due to increased work load for breathing.
In children, there might be behavioural problems, below expected performance in school, sleepiness during the day is less common but rather there is a tendency for hyperactivity.
Dental findings includes a possibility of retrognathic maxilla and / or retrognathic mandible, extended cervical posture with head tilted upwards, enlarged tongue, elongated soft palate and deviated nasal septum.

7. DIAGNOSIS

Diagnosis should follow a systematic procedure that includes history, clinical examination and routine screening methods.
History and clinical features includes positive signs and symptoms of snoring, restless sleep, observed apnea, reports of nocturnal gasping, choking, observed sleepiness, presence of comorbidities like hypertension, diabetes, hypothyroidism, increased BMI (>30) and increased neck circumference.
SCREENING METHODS can be in the form of questionnaires (Berlin questionnaire, Sleep Disorder questionnaire, STOPBANG questionnaire, Kushida Index, Apnea Prediction Score, Friendman Classification, Modified mallampati Score).

A: **BERLIN QUESTIONNAIRE[1]:** It includes two categories of questions regarding occurrence of snoring, its frequency, any cessation of breathing. If the scoring concludes with 1 or no categories, the possibility of OSA is low while if the scoring is more than 2 categories, there is high risk of OSA. Category 3 is BMI greater than 30 kg/m^2. A note of this is made separately.

B: STOPBANG QUESTIONNAIRE[2]:

Introduced by Chung Frances in 2008, It has high sensitivity to diagnose the patients with moderate to severe OSA. High risk is obsereved when there are 3 or more symptoms related.
The questionnaire includes:
S : snoring
T : tiredness
O : observed events
P : blood pressure
B : BMI >35
A : Age > 50
N : Neck circumference >15.7 inches
G : gender – male predilection

C: EPSWORTH SLEEPINESS SCALE[3]

Given by Murray Johns In 1991 which is used to assess day time sleepiness. It does not diagnose sever OSA cases. There are 8 social circumstances and rated using a 4 point scale. The interpretation is less than 10 is considered normal, greater than 12 is considered with sleep disorder and a maximum score of 24 signifies definite OSA.
The 8 social circumstances include:
1. sitting and reading
2. watching TV
3. Sitting inactive at public place
4. As a passenger in a car for hours without break
5. Lying down to take rest in the afternoon when circumstance permit
6. Sitting and talking to someone
7. Sitting quietly after lunch
8. In a car stopped in traffic for few minutes.

D: CEPHALOMETRIC ANALYSIS[4]
As mentioned in McNamara 1984, upper and lower pharynx dimension can be measured to assess upper and lower airway width. Upper Pharynx width is measured from a point from posterior outline of the soft palate to the closest point on the posterior pharyngeal wall and has a normal range of 14.4- 20.4 mm. The lower pharyngeal width is measured from a point formed by the intersection of the tongue and inferior border of the mandible to the closest point on the posterior pharyngeal wall and it has a normal range of 10-14mm in females and 10-17mm in males. The width remains stable and does not change with age. Other regions that can be assessed include retrognathic maxilla and/ or mandible, Large ANB, extended cervical posture, inferiorly placed hyoid bone.

E: COMPUTED TOMOGRAPHY[5]
According to Carlos et Al, Journal of Brasileiro de Pneumonologia, CT can be used as an investigation on imaging patients with OSA. The axial slices are used to assess for increased soft tissue *fat, muscle, lymphoid tissue) volume in oropharyngeal region.

F: MAGNETIC RESONANCE IMAGING[6]
MRI is a non invasive technique that provides accurate resolution and image quality of soft tissue on the neck. It may contribute to understanding of the mechanism of apnea by providing excellent resolution of upper airway and soft tissue including adipose tissue. It allows imaging in the axial, sagittal and coronal planes and does not subject the patients to radiation.

G: FRIEDMAN CLASSIFICATION[7]
It was given by Dr. Michael Friedman in 1999 which determines tonsil size, MMP score and BMI index and correlates it to OSA.
Tonsil size is given a scoring of:
0 : when it has been removed surgically
1: hidden within tonsil pillars
2: extending to the pillars
3: extending beyond the pillars
4: extends to the midline
MMP scoring (given in 1983):
It is subdivided into:
I : Soft palate, fauces, uvula and pillars are visible
II : Soft palate, fauces and uvula are visible
III : Soft palate, fauces and base of uvula is visible
IV : soft palate is not visible
When there is a point increase in MMP, the OSA chances increases by more than twofold. MMP increases during pregnancy.

H: **OBJECTIVE TESTING**

It includes polysomnography and role of oximetry in diagnosing OSA.

8. POLYSOMNOGRAPHY

It refers to a systematic process that is concerned with sleep study. It utilizes a minimum of 12 channels of recording that include EEG (electroencephalogram). EOG (electrooculogram), EMG (Electromyogram), oronasal airflow, chest wall effort, body position, snore microphone, ECG and oxyhemoglobin saturation. Advantages of PSG include sleep staging and the recording of arousal, but there can be considerable interobserver variability in the scoring of arousal.

9. ROLE OF OXIMETRY

It is one of the simplest method of evaluating suspected OSAS by recording of SaO2 during sleep. It is often sufficient to diagnose severe cases of OSA due to their characteristic pattern of repetitive desaturation but cannot detect hypopnea or mild cases.

10. MANAGEMENT

In dental practice, the patients can be broadly categorised as a growing or non growing individual and according to the AHI, they can b either mild, moderate or severe.

	GROWING INDIVIDUAL	NON-GROWING INDIVIDUAL
MILD	BEHAVIORAL MODIFICATION/ MEDICATION/ POSITIVE AIRWAY THERAPY or APPLIANCES	BEHAVIORAL MODIFICATION/ MEDICATION/ POSITIVE AIRWAY THERAPY or APPLIANCES
MODERATE	APPLIANCES	APPLIANCES
SEVERE	SURGICAL CORRECTION	SURGICAL CORRECTION

1. LIFESTYLE MODIFICATON:

It is an adjunctive therapy which advises loss of weight to a MI of 25 kg/m^2 or less, exercise, positional therapy during sleep, i.e. non supine position, avoidance of alcohol and sedatives before sleep.

2. MEDICATIONS:

Correction of underlying morbidity is done. Thyroid hormone supplements are given which shows a significant correction of apnea if hypothyroidism/ hyperthyroidism is the underlying cause. Controlling of blood glucose level gives best to moderate effect in controlling diagnosed OSA. OPIOID antagonist and nicotine improves oxygenation but is not used clinically as they are short acting and disrupt sleep cycle. Acetazolamide produces metabolic acidosis, stimulates ventilator control which is helpful in periodic breathing patients. Tricyclic antidepressants increases upper airway neuromuscular activity, decreases REM sleep for mild apnea patients who do not tolerate CPAP or oral appliances.

3. POSITIVE AIRWAY PRESSURE THERAPY:

It includes CPAP, Autotritation, Bi-level Positive Airway Pressure

Continous Positive Airway Pressure Therapy (CPAP)

CPAP is administered at bedtime as a nasal or facial mask held in place around the patient's head.The mask is connected to a small air compressor which sends air under pressure through the tube into the mask,(imparts positive pressure to the upper airways) and "splints" the upper airway open and keeps it from collapsing in the deeper stages of REM sleep.

Autotritation:

Autotitration devices are designed to provide the minimum necessary pressure at any given time and change that pressure as the needs of the patient change. The Auto Set acts by monitoring the patient's inspiratory flow-time curve.

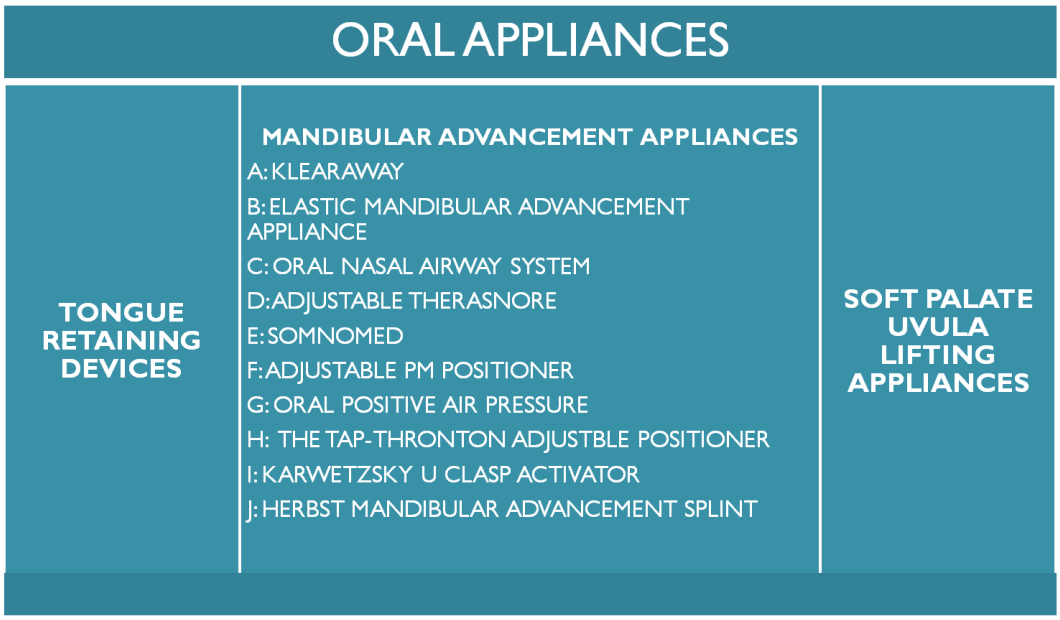
Bi-Level Positive Airway Pressure (BiPAP):

The air pressure required to prevent respiratory obstruction is typically less on expiration than on inspiration. The bi-level positive airway pressure machines are designed to sense when the patient is inhaling and exhaling and to reduce the pressure to a pre-set level on exhalation which aids in efficient

functioning of the lungs. Bi-level positive airway pressure machines usually are used when the patient does not tolerate CPAP or when the patient has more than one respiratory disorder.

4. ORAL APPLIANCES:

They are not the primary choice of treatment and can be used in mild to moderate OSA patients. The basic mode of function of these oral appliances are that they are used only during sleep, reposition the lower jaw, tongue, soft palate or uvula and maintain an open and unobstructed airway. It protrudes the mandible and tongue forwards and prevents upper airway from collapse during sleep.



INDICATIONS FOR ORAL APPLIANCES:

- Mild to moderate OSA and patients who do not exceed 125%-150% of their ideal body weight.
- Retrognathia
- Patients who do not agree for surgery.
- Patients who are medically compromised, or elderly or who cannot afford surgery.
- Patients who are non-compliant with CPAP.
- Patients who are mouth breathers or nose breathers
- As a diagnostic tool prior to maxillo-facial surgery

11. CONTRAINDICATIONS:

- Severe periodontal disease
- Existing temporomandibular joint disease (arthritis etc.)
- Painful masseter muscles
- Incomplete dentition which compromises retention of the appliance
- Atrophic edentulous ridges as evidenced by poor denture retention
- Severe hypoxemia
- Severe OSA
- Growing children

1. TONGUE RETAINING DEVICES:

Tongue-retaining devices were first described in 1982. They consist of a hollow bulb supported by trays that fit over the maxillary and mandibular teeth or edentulous ridges. The patient projects the tip of the tongue into a hollow bulb, thereby creating a suction which retains the tongue in an anterior position.

2. MANDIBULAR ADVANCEMENT DEVICES(MAD):

It was first described by Robin in 1934. In general, MAD consist of firm fitting trays that fit over the maxillary and mandibular teeth. They can be either adjustable or fixed in position. Adjustable appliances are preferred as they can be adjusted in anteroposterior direction until an acceptable

level of symptom improvement has occurred with simultaneous control over the teeth and temporomandibular joint sensitivity. Advancing the mandible puts a traction on the lateral walls and results in thinning of these walls.

12. SURGICAL PROCEDURES:

They are used in sever OSA patients who do not respond to lifestyle modification, CPAP, or oral appliances. Some of the common procedures include uvulopalatopharyngoplasty (involves the removal of part of the soft palate, uvula and redundant peripharyngeal tissues), maxillomandibular surgery comprising of orthognathic surgery or distraction osteogenesis (LeFort I osteotomy of the maxilla and Sagittal split advancement of the mandible which advances the soft tissue of the tongue and palate thereby opening the airway), or hyoid suspensions (advances the tongue base and epiglottis forward which is done through two horizontal incisions on a skin crease in the upper neck by detaching 2 tendons on the upper surface of the hyoid bone and securing it on the thyroid cartilage).

FEW STUDIES THAT SHOW IMPROVEMENT IN AIRWAY:

1. According to Tomonori Iwasaki et Al[8], A study on the improvement of nasal airway ventilation after rapid maxillary expansion evaluated with computational fluid dynamics, concludes that out of 18 patients, 12 patients showed significant decrease in nasal airway pressure after treatment with RME. The use of RME increases nasal cavity width by 2.73mm (transverse increase in nasal floor corresponds to 1/3rd the amount of maxillary expansion). The changes are measured at intermolar width and nasal airway. Computational fluid dynamics were used to assess nasal airway change with use of RME.
2. According to Chandrakant et Al[9], a study to assess the three-dimensional upper airway changes with mandibular advancement device in patients with obstructive sleep apnea concludes that MAD increases mean upper pharyngeal airway volume and the increase in volume appeared to be related to oxygen saturation.
3. According to MingLi Xiang et Al[10], a systematic review on changes in airway dimensions following functional appliances in growing patients with skeletal class II malocclusion, shows that early treatment with functional appliances can enlarge the upper airway dimensions specifically in the oropharyngeal region, in growing subjects with skeletal Class II malocclusion. Though recent articles say that functional appliance do not increase mandibular length but significant improvement in SNB reduces severity of OSA.

13. CONSEQUENCES

Early diagnosis and management of OSA is required to prevent unnecessary complications like congestive cardiac failure, stroke, high blood pressure, increased insulin resistance (even in non-diabetic patients), Impotence and lack of sex drive, Memory problems, etc.

ROLE OF ORTHODONTIST IN OSA[11]

According to Rolf G Behrents et Al, AJ0DO, a study on obstructive sleeo anea and orthodontics : An American Association of Orthodontist White Paper discusses on the prevalence, symptoms, diagnosis, significance , role of orthodontist and management and Goals for assessing the final outcome.

CRITERIA	INTERPRETATION
PREVALENCE	14% in men, 5% in women
SYMPTOMS	h/o snoring, gasping for breath, pauses in breathing, morning headache, comorbidities (diabetes, obesity, hypothyroidism)
DIAGNOSIS	PSG(sleep study), clinical examination, cephalometric parameters, questionnaire
SIGNIFICANCE	chronic intermittent hypoxemia, heightened inflammation, endo thelial damage – Coronary Artery Disease, Cardiac Arhythmia, Stroke
ROLE OF ORTHODONTIST	CLINICAL EXAMINATION : Mallampati Score, tongue position, maxillomandibular relationship
	RADIOGRAPH : CBCT (morphological variation in hard and soft tissue with better spatial resolution)
MANAGEMENT	treatment and management shall not take place without referral from a physician,informed consent to be obtained prior to commencing any Oral Appliances,follow up every 6 months during the 1st year, then annually
GOALS	eliminate snoring, normalize AHI, normalize Oxygen Saturation, resolution of patient's initial symptoms of OSA

14. CONCLUSION

Obstructive sleep apnea is a common sleep disorder that can be diagnosed at an early age. The role of orthodontist in diagnosing a case of OSA is important. It involves a multidisciplinary approach to reduces consequences that can arise when such patients are left untreated.

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