SLEEP APNEA – DO ORTHODONTIST HAVE A ROLE

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ABSTRACT

Aim and Objective: To provide a detailed description about sleep apnea regarding its signs and symptoms, pathophysiology, prevalence and its risk factors, currently available treatment modalities and the role of oral appliance therapy.

Material and Method: Electronic searching was done in PubMed, Medline, EMBASE and CENTRAL databases. Inclusion criteria were: dental, oral and maxillofacial oriented articles.

Conclusion: A team approach of physicians and orthodontist is required for treatment of Sleep Apnea. The physician diagnosis a patient with sleep apnea and determines whether the patient is medically fit to wear oral appliance. It is orthodontists’ responsibility to evaluate dental status for oral appliance therapy and conduct long term follow up.

KEYWORDS: Palatal Guide Flange, Deviated Mandible, Ossifying Fibroma, Mandibular Resection.

INTRODUCTION - Sleep Apnea is one of the common sleeping disorders in which person has difficulty in breathing while sleeping. There is decreased amount of oxygen a person takes in his or her lungs. Low blood oxygen levels then trigger the brain to breathe again. The person gasps and there is a pause which lasts for few seconds. Then normal breathing starts again.

There are three different types of sleep apnea:
- Obstructive sleep apnea (OSA)
- Central sleep apnea
- Mixed sleep apnea

OBSTRUCTIVE SLEEP APNEA

This is the most common type of sleep apnea.¹ There is an upper airway obstruction, despite much efforts made by lungs, due to collapse of soft tissue at the rear of the throat. Obstructive sleep apnea (OSA) is a potentially life threatening disorder characterized by repeated collapse of the upper airway during sleep, with periodic cessation of breathing (for more than 10 seconds). These events usually result in fragmented sleep.

The obstruction can be partial or complete, both result in desaturation of oxygen.

The site of obstruction could be posterior to the soft palate or posterior to the base
of tongue regions. This disorder is also known as Obstructive Sleep Apnea Hypopnea Syndrome (OSAHS) as there is complete cessation or substantial reduction in oro-nasal airflow. According to American Academy of Sleep Medicine, OSAHS is defined as combination of symptoms (such as excessive daytime sleepiness).

Laboratory investigations include: Respiratory Disturbances Index (RDI)

On the basis of RDI, OSAHS can be classified as: Mild, Moderate and Severe (Table I)

In central sleep apnea there is failure on the brain part to control breathing. In mixed sleep apnea there is combination of physical blockage and inability to breathe by lack of brain signalling.3

Prevalence and risk factors:

OSA affects at least 4% of men and 2% of women and more than 10% of the population over the age of 65.6 It has been seen that sleep apnea often goes undiagnosed as it occurs during sleep so individual is unaware of it. Increase in age can be considered as contributing factor to OSAHS.8

OSAHS also appears to be more common in several endocrine disorders, like hypothyroidism, acromegaly, Cushing Syndrome, and diabetes mellitus. Other risk factors for OSAHS are familial aggregation, obesity, central body fat distribution, large neck girth, genetics, smoking, menopause, alcohol consumption before sleep, night time nasal congestion and craniofacial and upper airway abnormalities like retro- or micro-gnathia, macroglossia, adenotonsillar hypertrophy, long face and inferior positioning of the hyoid bone1,2,8.

In addition, tendencies toward a reduced cranial base length and angle, a large ANB angle, a steep mandibular plane angle, elongated maxillary and mandibular teeth, narrowing of the upper airway, a long and large soft palate, and a large tongue have also been reported2. Several intoxications may cause predisposition to upper-airway obstruction during sleep, including the use of tobacco, alcohol, and respiratory depressant or sedative medication.1

**PATHOPHYSIOLOGY**

Muscle tone except extraocular muscle movements are usually decreased in all states of sleep. In normal persons, this muscle relaxation does not cause reduction in respiratory flow volumes. But in persons with sleep apnea, the oropharyngeal muscle flaccidity along with anatomical and other predisposing factors leads to obstruction of upper airway. The disturbances in blood chemistry result in catecholamine production and a subsequent cardio-pulmonary sequel. The cycle of sleep—obstruction–arousal–sleep, is repeated throughout the night and causes alterations in the normal REM/NREM sleep cycle, often causing relative sleep deprivation that culminates in day time sleepiness. (Table II)

**Diagnosis:**

- Sleep history
- Clinical examination of upper airway
- Supporting questionnaires
- Overnight sleep monitoring by polysomnography
- The Epworth sleepiness scale (ESS) questionnaire
Polysomnography is the “gold standard” for making the diagnosis and includes the various physiologic measures. ESS questionnaire generates the likelihood of falling asleep in eight different situations.\textsuperscript{11} It must be noted that the polysomnographic diagnostic criteria for OSA in children are somewhat different from those in adults. Among children, an AHI > 1 and oxygen desaturation $\geq$ 4% are indicators of mild OSA.\textsuperscript{22,23} In comparison, an AHI of 5 (or sometimes 10) among adults generally indicates mild OSA.\textsuperscript{2} An individual with RDI of more than 5, in combination with daytime sleepiness and or cardiovascular disease is considered to have obstructive sleep apnea.\textsuperscript{11} OSAHS is distinguished from simple snoring which is associated with a physiological number of airway obstructions and the absence of OSAHS-related symptoms.\textsuperscript{1}

Signs and Symptoms:
01. Excessive daytime sleepiness
02. Interrupted night snoring by pause in breath
03. Loss of energy
04. Fatigue
05. Restless sleep
06. High blood pressure
07. Overweight
08. Personality change
09. Irritability
10. Sexual dysfunction
11. Nocturia
12. Trouble concentrating
13. Forgetfulness

Treatment:
Mild cases are treated by nonsurgical methods. Patient is advised to take proper rest and sleep for at least 8 hours daily. This will improve sleep-awake patterns. Also patient is advised to change the sleep position from supine to lateral or upright in supine dependent upper-airway obstruction. Eliminating other various risk factors along with weight reduction is the treatment modality for sleep apnea. Avoiding alcohol, tobacco in any form, respiratory depressants or sedatives can also help patient to cope up with sleep apnea.\textsuperscript{1}

For treatment of mandibular deficiency and upper airway obstruction, oral appliances was considered as early as 1902. Various designs in oral appliances have been proposed and studied to treat patients with sleep apnea.\textsuperscript{24} Several advantages and disadvantages are as follows:

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<tr>
<th>ADVANTAGE</th>
<th>DISADVANTAGE</th>
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<td>Simple to use</td>
<td>Oral discomfort</td>
</tr>
<tr>
<td>Tolerable to patient</td>
<td>TMJ pain</td>
</tr>
<tr>
<td>Non-evasive</td>
<td>Muscle stiffness</td>
</tr>
<tr>
<td>Low complication rate</td>
<td>Excessive salivation or mucosal dryness</td>
</tr>
<tr>
<td>Cost effective</td>
<td>A temporary bite change in the morning</td>
</tr>
<tr>
<td>Portable</td>
<td>Minor dental and skeletal changes</td>
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Several oral appliances are available for sleep apnea patients. Such as tongue repositioning devices, palatal lifting devices, tongue post uretrainers, labial shields, and mandibular repositioning appliances.1,16

1) A Tongue Repositioning Device (Figure 1): It is custom made soft acrylic appliance. It covers the maxillary as well as mandibular teeth. Negative pressure is exerted by an anterior plastic bulb that holds the tongue in forward position inside the bulb. It is usually prescribed in patients with macroglossia.15,16

2) Palatal Lift Devices (Figure 2): They are not frequently used as they results in limited efficiency & compliance. Labial shields are not so popular and are not routinely prescribed.

3) Mandibular Repositioning Device (Figure 3): There are different types of mandibular repositioning appliances (MRA). This appliance helps in advancement of mandible as they are derived from functional orthodontic appliance.14 Mandibular repositioning appliance can either be one piece (monobloc) or two pieces (bibloc). They are either custom-made or prefabricated. They may be adjustable (titratable) or nonadjustable.1,15 Mandibular Repositioning Appliance helps in forward placement of mandible. This has two effects: (a) It moves the base of the tongue anteriorly, which in turn increases the retroglossal airway space. (b) Anterior movement of the tongue not only decreases the gravitational effect on the soft palate, but also results in anterior movement of the soft palate via the palatoglossal arches leading to the reduction in the collapsibility of the velopharynx.12,16,19

Different studies have given various guidelines for appliance adjustment.6,12,16 The adjustable appliance must be well titrated by dentist to obtain desired therapeutic efficacy.

According to a group of researchers vertical should be kept small. If it’s too large there will be decrease in posterior airway space will occur, instead of increase. There is a need of a certain amount of horizontal mandibular repositioning to obtain oropharyngeal enlargement in order to reposition the tongue forward with the genioglossus muscle, the hyoid bone (geniohyoid), and the anterior and posterior wall of the oropharyngeal and hypo-pharyngeal area (pharyngeal constrictor), rather than vertical.6

In one of the recent studies, it is said that the efficacy of oral appliances decrease over time.15

The long term decrease in efficacy of these appliances could be of various reasons:

- Increase in body mass index (BMI)
- Change in sleeping position.
- Alcohol consumption.
- Loss of initial tightness and return of increased muscle tone of suprahyoidal musculature.
- Adaptation of the soft tissues to mandibular advancement.

Patient-reported compliance with MRA therapy is generally high, with studies reporting regular use in 75 to 100% of patients, although long-term compliance has been reported to decrease over time.1

4) Twin Block And Herbst Appliance (Figure 4): In a study, researchers
concluded that treatment of obstructive sleep apnea is effective when twin block and and Herbst appliance were compared. The side effects of both appliances are minor and decrease with time.

However, the cost of Twin Block is less than that of Herbst. Other experts also compared the Herbst appliance with Monobloc and reached the conclusion that Apnea Hyponea Index decreases to less than 10 in 75% of patients with Monobloc and in 67% of the patients with the Herbst Appliance.25

5. Nasal Continuous Positive Airway Pressure (NCPAP) (Figure 5): It is another Non-surgical method for treating OSA, which was first introduced in 1981. CPAP is considered a first-line treatment for symptomatic patients with sleep apnea-hypopnea syndrome (SAHS) also to those who have significant functional impairment and even for patients with mild OSA. It delivers positive airway pressure through a tightly sealed nasal mask. A constant pneumatic pressure is maintained in the upper airway, which prevents collapse during nocturnal respiration.7

Major drawbacks of NCPAP are:
1. Poor compliance
2. Allergy to the face mask
3. Air leaks
4. Abrasions on the ridge of the nose
5. Dry nose or mouth in the morning
6. Nasal congestion

CPAP is more effective in treating snoring, improving AHI and oxygenation. A variety of studies concluded that mandibular advancement devices are better tolerated in mild to moderate sleep apnea and are preferred to nasal CPAP.16, 17, 18

Moderate to severe cases are treated by surgical interventions. Interventions such as:

1. Tracheostomy: Tracheostomy in early days provided complete solution with most predictable surgical intervention before the development of NCPAP. Nowadays, this technique is only used in most extreme patient condition with severe daytime somnolence or cardiovascular sequel.7 One study concluded that tracheotomy effectively treated patients with uncomplicated OSA, but was much less effective in treating patients with OSA and cardiopulmonary decompensation.10

2. Uvulopalatopharyngoplasty: Fujita et al in 1981 introduced uvulopalatopharyngoplasty (UPPP) as one a treatment modality other than tracheotomy.7 The success rate of UPPP alone in all patients with OSA is in the range of only 40-50%1, 4, 7 UPPP is theoretically more successful if performed only on those patients with narrowing or collapse in the region of the oropharynx and velum6. Thus, the success rate is even lower (5%) when the level of collapse is in the retroglossal area.4 The laser assisted uvulopalatoplasty (LAUP) show a worthwhile option for snoring, but produces minimal results for mild OSA.7

3. Genioglossus Advancement With Hyoid Advancement: In Genioglossus advancement with hyoid myotomy (GAHM) expands the hypopharyngeal region at the tongue base by advancing the genial tubercle and hyoid bone.7

4. Maxillo-Mandibular Advancement: Maxillomandibular advancement provides maximal enlargement of the
5. Radiofrequency Volumetric Tissue Reduction Technique: Radiofrequency Ablation of the soft palate and tongue base has also been recently introduced as an alternative for OSA Preliminary reports using this technique have been encouraging.

Table I: Classification of OSAHS

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<th>S.NO</th>
<th>TYPE</th>
<th>RDI</th>
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<tr>
<td>01.</td>
<td>MILD</td>
<td>5-15</td>
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<tr>
<td>02.</td>
<td>MODERATE</td>
<td>15-30</td>
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<tr>
<td>03.</td>
<td>SEVERE</td>
<td>&gt;30</td>
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Table 2: Pathophysiology of Sleep Apnea

Normal sleep

After 90 minutes

Rapid eye movement (REM) stage

More time of sleep is spent

Non-rapid eye movement (NREM) stage

Less time of sleep is spent

CONCLUSION

A team approach of physicians and orthodontist is required for treatment of Sleep Apnea. The physician diagnosis a patient with sleep apnea and determines whether the patient is medically fit to wear oral appliance. It is orthodontists’ responsibility to evaluate dental status for oral appliance therapy and conduct long term follow up. This includes optimizing the appliance, monitoring its retention and assessing its effectiveness and intervening any side effects.
Figure 1: Tongue repositioning device (Reproduced from www.somnosure.com-the best dental snoring mouthpiece: types options)

Figure 2a: Intraoral view of edentulous interim palatal lifting devices
Figure 2b: Dentulous palatal Lift Device
Figure 2c: Intraoral view of dentulous interim palatal lift device. (Reproduced with permission from Raj N, Raj V, Aeran H; J Adv Prosthodontics 2012 November 4(4)243-247)

Figure 3 a: Restricted airway during sleep. b-Mandibular repositioning device increasing airway space. (Reproduced from www.webmd.com/sleep-disorders/sleep-apnea/mandibular-repositining-device)
Figure 4 (a) Herbst Appliance
(b) Twin block

Figure 5: Continuous Positive Airway Pressure Device (Courtesy Delhi Heart and Lung Institute; punchkuina road, New Delhi, India)

REFERENCES


