

# Etiology, Diagnosis, Treatment Planning, and Role of Orthodontists in Adult OSA: A Review Article

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## Abstract:

Obstructive Sleep Apnea is a medical disorder that can lead to serious consequences if left untreated. OSA can affect children and adults at any point in their life. It has a higher prevalence in adults. Orthodontists can help in identification of OSA by screening their patients actively for the presence of OSA. When OSA is suspected by an orthodontist, the patient should be referred to the physician for final diagnosis. The examination of airway by two dimensional radiographs is inadequate and therefore, cone beam computed tomography can be used for measuring airway volume. Mini-screw assisted rapid palatal expansion appliances, oral advancement appliances, and orthognathic surgery are the options that an orthodontist can use for such patients. This article describes in detail regarding adult OSA, its etiology and the role of orthodontists in OSA.

**Keywords:** Obstructive Sleep Apnea, orthodontics, orthodontists, medical disorders, breathing disorders, respiratory distress.

## Introduction

The orthodontic specialty includes not only the treatment of moving the teeth but also other aspects of orofacial and overall health. The management of obstructive sleep apnea is one such topic. Therefore, there is an increased attention by orthodontists in the screening, identification, and diagnosis of obstructive sleep apnea.<sup>1</sup> Currently, a lot of studies are focused on how an orthodontist practitioner can benefit the patients, both children and adults alike in the screening, diagnosis, and management of OSA.<sup>2-5</sup> Orthodontics have an extensive training in growth and development of face, head, and neck structures. Along with the expertise in growth, orthodontists are also knowledgeable in oral devices, and thus are well suited to be a part of the interdisciplinary team for management of OSA.

The definitive diagnosis of OSA is performed by a physician.<sup>6</sup> Orthodontists can contribute by screening the patients for OSA and contribute their part by identifying the dentofacial components. The care of OSA is performed by multiple doctors and is a shared effort by the members of this interdisciplinary team. Patients with OSA do not always present to the physician.<sup>7</sup> Many patients are unaware that they have OSA. Patients with OSA present to orthodontics in different ways. A patient who has been diagnosed as having OSA by the primary care physician could refer the patient to the orthodontist for management with an oral appliance or performing orthodontic treatment on such patients for the treatment of OSA.<sup>8</sup> Some patients may present to the orthodontist with some concerns about breathing at night during sleep. In other situations, some patients are unaware of OSA totally and are identifying by screening questionnaire through the orthodontists' office.<sup>9-13</sup> Such patients are then referred to the physician for further evaluation and final diagnosis.

Multiple dental, sleep, and orthodontic associations have put forth the considerations for OSA such as American Dental Association, American Academy of Dental Sleep Medicine, American Academy of Sleep Medicine, European Respiratory Society, Australian Dental Association, American Association of Oral and Maxillofacial Surgeons, American College of Prosthodontists, American Academy of Pediatric Dentistry, Canadian Dental Sleep Medicine, Canadian Thoracic Society, American Academy of Pediatrics, United States Preventative Respiratory Society, etc.<sup>1</sup> This article will review the current considerations for orthodontists on their role in the management of OSA.

## Adult OSA

Breathing disorders related to sleep are a separate category of diseases classified as sleep-related breathing disorders (SRBDs). It constitutes obstructive phenomena, with snoring, upper airway resistance syndrome, and Obstructive Sleep Apnea, along with related central sleep apnea and sleep related hypoventilation. OSA shows particularly high prevalence in adult patients who are over 18 years of age.<sup>14,15</sup> The clinical concerns for other types of sleep-related breathing disorders such as insomnia, central disorders of hypersomnolence, circadian rhythm sleep-wake disorders, sleep-related movement disorders, parasomnias, should be referred to the physician or the primary care provider for a detailed assessment and management. A sleep medicine physician may be a preferred choice for such disorders. An orthodontist can make a referral to the otolaryngologist in patients with nasal obstruction or adenotonsillar hypertrophy.

## Etiology of OSA

Pressure of pharynx is the pressure at which the upper airway collapses. The collapsibility of the pharynx is worsened even more by the lack of neuromuscular tone of the upper airway pharyngeal muscles. The respiratory effort has to increase in order to maintain the airway through the constricted airway passage. This results in an increase in the level of carbon dioxide in the blood and decrease in the level of oxygen in the blood.<sup>16</sup> The increased work required for breathing during sleep can result in a cortical arousal while sleeping, which can cause a higher sympathetic neural activity, and increase in heart rate, blood pressure, and tendency for cardiac arrhythmias.<sup>17-19</sup> When the arousal from sleep occurs, the normal breathing is reestablished and there is a gradual return to sleep, with the same phenomenon repeating leading to recurrent airway collapsibility. This whole cycle of disruption in the normal breathing process may occur multiple times during the sleep cycle of patient.

## Role of Orthodontists in OSA: Imaging Modalities for Airway

The imaging modalities used in orthodontics may help in assessing OSA. The conventional radiographic cephalograms obtained by an orthodontist are two dimensional and therefore their use is limited. Such radiographs do not show the transverse information regarding the airway dimensions and therefore are of little value.<sup>20</sup> Cone Beam Computed Tomography (CBCT) can allow the measurement of volumetric information of the pharyngeal and nasal airway.<sup>21</sup> In addition, it also allows the measurement of minimal cross-sectional area which enables the measurement of the area of the pharyngeal airway which shows the least amount of airway space.<sup>21</sup> The minimal cross sectional area is lower in patients with sleep apnea than in patients with normal breathing. It has been shown that certain orthodontic interventional such as mini-screw assisted rapid palatal expansion (MARPE) can cause an increase in the minimal cross-sectional area compared to controls and therefore have some positive effects in reducing the apnea.<sup>21</sup>

## Role of Orthodontists in OSA: Diagnosis and Treatment Planning

The treatment plan for OSA patients should be based on the consideration of the needs of the patient and the goals of treatment.<sup>22</sup> There are multiple options available for the selection of orthodontic appliances such as mini-screw assisted rapid palatal expansion appliance (MARPE), rapid maxillary expansion (RME), oral advancement appliances.<sup>21,23,24</sup> If the individual patient also suffers from specific malocclusions then that should be taken into consideration while performing the treatment planning procedure. For example, a patient with Class III malocclusion and OSA can be benefited from orthopedic approach of protraction of maxilla.<sup>25</sup> In such cases, the orthopedic treatment will benefit the malocclusion and the airway issues.<sup>26</sup> Orthopedic treatment involving MARPE has an advantage that the mini-screw in the palatal have a success rate of over 90%.<sup>27</sup> If the patients have severe malocclusions then surgical consideration must be taken into account for the correction of the malocclusion. In class III malocclusions, the surgical advancement of maxilla have shown to have beneficial effects on airway. Surgical expansion of maxillary arch has also been suggested in adult patients.<sup>28-31</sup> However, surgical interventions may affect the Temporomandibular Joint negatively at times. Therefore, some non-surgical alternatives such as mini-screw assisted rapid palatal expansion can be used in such patients as it has shown to not affect the TMJ.<sup>32</sup> In adult patients, when using MARPE approach as an alternative to surgical approaches, osteoperforations can be done to increase the amount of maxillary suture opening.<sup>33,34</sup>

Oral advancement appliances have been used for the treatment of OSA. Such appliances can lead to increase in the oral volume during sleep and pull the tongue forward. This can help in reducing the severity of sleep apnea and achieving a better quality of sleep.<sup>35</sup> However, such appliances can lead to an increase in the proclination of mandibular incisors and consequently risk periodontal side effects such as root resorption.<sup>36</sup> On the other hand, procedures like mini-screw assisted rapid palatal expansion do not lead to root resorption as shown in a recent research study.<sup>37</sup> If at all the treatment plan for OSA includes orthodontics, then the treatment-plan, treatment monitoring, and long term follow up with patient should be included in the plan and it should ideally be prepared by all the practitioners involved in the management of OSA. The oral advancement appliances have been shown to reduce the overbite in the long term assessment.<sup>38</sup> Other orthodontic treatment options for complex malocclusions involve mini-screws insertion into the ramus for the uprighting of the impacted molars.<sup>39,40</sup>

This can lead to decreased overbite due to extrusion of molars and consequently increased mandibular plane angle. However, whether the opening of mandibular plane angle has any significant effect on OSA is yet to be determined. The treatment progress should be coordinated by effective communication between the orthodontists and other practitioners involved in the patient treatment. The treatment usually begins with the recommendation and referral from the physician regarding orthodontic management to help in OSA.

Esthetic treatment options such as lingual orthodontics and aligner therapy can also be used for orthodontic management. Aligners have shown the class II advancement protocol for mandible in treatment of malocclusions with increased overjet.<sup>41</sup> This can be useful as an oral advancement device for patients with OSA.<sup>42</sup> However, the efficacy of such aligners has not been tested yet to identify whether they perform in a similar fashion to that of oral advancement appliances.

## Conclusion

Obstructive Sleep Apnea is a medical disorder that can result in serious consequences if left untreated. OSA can affect both children and adults with a higher prevalence in adult population. Orthodontists can incorporate OSA screening into their normal protocol and identify the patients with high risk at OSA. A referral to the physician shall be made for patients with risk at OSA for a comprehensive diagnosis. Orthodontists can refer the adult OSA patients to otolaryngologist when presented with nasal obstruction or adenotonsillar hypertrophy. Orthodontist monitors and coordinates with different health professionals regarding the treatment progress and communicates with the team. Orthodontic treatment has not shown to cause or increase the changes of OSA. Rather, some types of orthodontic treatment can be beneficial in reducing the severity of OSA.

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