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Obstructive Sleep Apnoea: Review Article

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Abstract

Obstructive sleep apnoea (OSA) is a relatively common disorder that affects people of all ages, but is most prevalent among the middle-aged and elderly. Affected individuals experience repeated collapse and obstruction of the upper airway during sleep, which results in reduced airflow (hypopnoea) or complete airflow cessation (apnoea), oxygen desaturation, and arousals from sleep. Adverse clinical outcomes associated with OSA include: cardiovascular disease, hypertension, non-insulin dependent diabetes, and increased likelihood of motor vehicle and other accidents due to daytime hypersomnolence. Studies estimate the prevalence of OSA at approximately 10 to 20 percent of middle-aged and older adults. Evidence also indicates that these rates are rising, likely due to increasing rates of obesity. The assessment might include at-home or in-hospital monitoring. A differential diagnosis of snoring or the type and severity of sleep-disordered breathing is communicated to the orthodontist at the time of referral. The orthodontist examines the patient to determine which oral appliance is best suited to his or her needs. Orthodontists who get involved in this form of therapy are often surprised at how grateful their patients are after only a few nights of sleep without interruption and the subsequent restoration of adequate sleep. Substantially changing the quality of a patient's life with an oral appliance can be a very rewarding experience. Present article is the systemic review of literature regarding the studies done from past 70 years regarding about OSA, etiology, diagnosis & its treatment planning.

Keywords: Obstructive sleep apnoea; Etiology

Abbreviations: OSA: Obstructive Sleep Apnoea; PSG: Polysomnography.

Introduction

Obstructive sleep apnea (OSA) is a sleep-related breathing disorder that involves a decrease or complete halt in airflow despite an ongoing effort to breathe. It is a potentially life-threatening disorder, estimated to affect 3.9% of Men and 1.2% of Women [1]. Snoring and excessive daytime sleepiness are the most common presenting complaints. It occurs when the muscles relax during sleep, causing soft tissue in the back of the throat to collapse and block the upper airway. This leads to partial reductions (hypopnoeas) and complete pauses (apnoeas) in breathing that last at least for 10 seconds during sleep. Most pauses last between 10 and 30 seconds, but some may persist for one minute or longer. This can lead to abrupt reductions in blood oxygen saturation, with oxygen levels falling as much as 40 percent or more in severe cases [2].

The brain responds to the lack of oxygen by alerting the body, causing a brief arousal from sleep that restores normal breathing. This pattern can occur hundreds of times in one night. The result is a fragmented quality of sleep that often produces an excessive level of daytime sleepiness [3]. Most people with OSA snore loudly and frequently, with periods of silence when airflow is reduced or blocked. They then make choking, snorting or gasping sounds when their airway reopens [4,5].

As the general public and our specialty better recognize the interactions between craniofacial form and overall health, orthodontists might be expected to become proficient in a broader range of health issues [6]. Snoring and obstructive sleep apnea is such a field in which more than 80 different oral appliances are currently available to treat snoring and sleep apnea, and the public's demands on orthodontists continue to increase [7,8]. This dissertation contains articles of particular interest to orthodontists, who, based on their knowledge of functional appliances and skills in evaluating jaw position and tooth movement, are ideally suited to provide oral-appliance therapy.

Under current Canadian guidelines, patients who require oral appliances for treatment of snoring and obstructive sleep apnea are referred directly to orthodontists by an attending sleep physician or a family physician after an assessment of the sleep disorder [9]. Orthodontists who get involved in this form of therapy are often surprised at how grateful their patients are after only a few nights of sleep without interruption and the subsequent restoration of adequate sleep. Substantially changing the quality of a patient's life with an oral appliance can be a very rewarding experience [10].

Sir William Osler [11] in 1918 coined the term "Pickwickian" to refer to obese, hypersomnolent patients. Downs WB [12] in 1948 developed a cephalometric analysis at the University of Illinois. The control material studied was derived from twenty living individuals, ranging in age from 12 to 17 years. Models, photographs, cephalometric and intraoral roentgenograms were taken of each. All individuals possessed clinically excellent occlusions. Downs pioneering work inspired many orthodontists to establish various normal reference standards. Brodie in 1950 [13] pointed out that as man assumed an upright posture the head had to be balanced on the vertebral column. This is attained by equal anterior and posterior muscle tension relative to the occipital condyles. In the accomplishment of this delicate cranial balance and posture, the hyoid bone plays an important and active part. Elbert W King [14] in 1952 noted that changes in head position lead to changes in the position of the hyoid bone in the same person. If the head is extended back, then the hyoid bone moves back; if the head is tipped forward, then the hyoid bone moves forward.

Tweed CH [15] in 1954 developed a cephalometric analysis for orthodontic treatment planning based on a triangle formed by Frankfort horizontal plane, Mandibular plane, and long axis of mandibular incisor. His analysis was based on a study he conducted on forty five individuals. He proposed the mean values of FMA, IMPA and FMIA – as 24.9°, 86.6° and 68.6° respectively. Burwell, et al. [16] in 1956 described several obese, hypersomnolent patients with respiratory and cardiac failure coined the term "Pickwickian Syndrome". Grant [17] in 1959 studied the position of the hyoid in Class I, II and III malocclusion. In this study one cephalometric roentgenogram for each subject was selected from an orthodontic school file. Grant concluded that the hyoid position is constant in the three types of malocclusion; he also said that the musculature and not the occlusion of the teeth, determines the position of the hyoid. He found that the hyoid level, in his teenage sample, was midway between the third and fourth cervical vertebrae. Bench [18] in 1963 studied the growth of the cervical vertebrae and related structures. He found that as the child develops, the hyoid moves downward in conjunction with cervical vertebral growth. The level of the hyoid drops from the third cervical vertebra at age 3 to the fourth cervical vertebra in adulthood.

Schudy FF [19] in 1964 stated that the proportion of facial depth has not only a direct bearing upon facial type but also a direct influence upon vertical overbite and function. The interplay of anterior vertical facial growth increments and posterior vertical growth increments, together with anteroposterior growth is responsible for normal occlusions as well as malocclusions. Gastaut, et al. [20] in 1965 described obstructive sleep apnea and associate it with hypersomnia in obese patients in Pickwickian syndrome. These French group of incestegators were the first to co-relate OSA to Obese subjects. Remmers & Sauerland [21] in 1970 described respiratory control of the upper airway and reduced activation during sleep. They found that maintaining the upper airway will enhance breathing during sleep.

Nahoum HI [22] in 1971 in his study stated most malocclusions have a vertical component as well as an antero-posterior malrelationship. Information about the vertical balance of the face is extremely useful in diagnosis and treatment planning, as most experienced clinicians agree that malocclusions with marked vertical facial imbalance are generally more difficult to treat than the primarily anteroposterior discrepancies. Handelman CS & Osborne G [23] in 1976 studied the dimensions of the nasopharynx in a longitudinal sample from one to eighteen years. Quantification allowed plotting distinctive growth patterns of the bony nasopharynx, the adenoids, as well as airway capacity. The evolving facial pattern was related to the evolving nasopharyngeal pattern to identify possible relationships. All measurements were derived from lateral cephalometric films.

Graber LW [24] in 1978 stated that the hyoid bone supported by its muscular and ligamentous attachments has broader physiological ramifications as it provides a functional interface between mandibular, functional and cranial structures. Slight variations in head position in the cephalostat, the postural position of the spine, and the state of function (rest or swallow) all affect the position of the hyoid bone. Holmberg H & Linder Aronson S [25] in 1979 carried out an investigation to clarify the value of lateral skull and frontal radiographs as a means of evaluating nasal respiratory function. Bibby RE [26] in 1981 opined that the hyoid bone is connected to the pharynx, mandible and cranium through muscles and ligaments. It is the only bone of the body that has no bony articulations.

Sullivan [27] in 1981 described the dramatic effect of nasal continuous positive airway pressure (CPAP) on OSA.CPAP became the dominant therapy in the 1990s.Approximately 55 percent success rate was observed by treating the patients of OSA with CPAP. Fujita [28] in 1981 reported the first cases of OSA treated by soft palate surgery (uvulopalatopharyngoplasty UPPP).This procedure was found effective in eliminating snoring; however, it is not necessarily curative for OSA, because areas of the airway other than the soft palate also collapse in most patients with this sleep Disorder . The success of this technique may range from 30 to 60 percent.

McNamara JA [29] in 1984 measured upper pharyngeal width as the shortest distance between posterior pharyngeal wall and a point located at the upper surface of soft palate (in its anterior half) to evaluate superior part of pharynx in lateral cephalogram. Apparent airway obstruction, as indicated by an opening of 5 mm or less in the upper pharyngeal measurement, can be used only as an indicator of possible airway impairment. Solow B, et al. [30] in 1986 studied the three sets of associations in a single group of nonpathologic subjects with no history of airway obstruction. A large craniocervical angle was seen in connection with small mandible dimensions, mandibular retrognathism and a large mandibular inclination.

Alan, et al. [31] in 1986 gave cephalometric & computed tomographic predictors of OSA. They demonstrated that there is cessation of respiratory efforts in Obstructive Sleep Apnea, the effort is simply rendered ineffective by the obstruction and it is in this condition that Orthodontist may best participate in curing the symptoms. Earle F Cote [9] in 1988 gave the description of OSA and its ramifications , with a case report on diagnosis and treatment plan and found that it could be relieved by orthognathic surgeries and with orthodontic treatment as well. He also mentioned weight reduction in obese patients who suffer from OSA as the best non-surgical treatment option.

Behlfelt K, et al. [32] in 1990 The study results showed that compared with the control children, children with enlarged tonsils had an extended posture of the head, a lowered position of the hyoid bone, and antero-inferior posture of the tongue. The vertical position of the hyoid bone also reflected the vertical position of the tongue. The anteroposterior position of the tongue was closely related to the oropharyngeal depth. The postural pattern in children with enlarged tonsils appears to be associated with the need for maintainence of free oropharyngeal airway capacity. Shepard JWJ and co-workers [33] in 1991 utilized cephalometric roentgenograms to study the relationships between breathing and craniofacial development in children and concluded that it is important to recognize that the largest increments in craniofacial growth occur within the first 4 yr of life and that craniofacial skeletal development is 90% complete by 12 yr of age.

Ioannis P, et al. [34] in 1992 investigated the hyoid bone position and inclination on the cephalometric radiographs of two groups of patients exhibiting Class I and Class III malocclusions. Class III patients, especially the boys, showed a more anterior position of the hyoid bone and also a reverse inclination. This might have an implication on the function of the suprahyoid and infrahyoid muscles and thus on the direction of mandibular growth. Young, et al. [35] reported in 1993 the first reliable estimate of the population prevalence of OSA in adults: 4% and 2% of middle-aged men and women, respectively, are sleepy and have increased obstructive sleep apnea.

Takashi, et al. [36] in 1995 described the effect of tongue retarining device on genioglossus muscle activity in subjects with severe obstructive sleep apnea by conducting two overnight sleep studies carried out with two TRDs, one with bulb (TRD-A) and one without bulb (TRD-B).Fluctuating GG EMG activity was found when no bulb was used however AH Index reduced with both TRDs. Miles, et al. [37] in 1996 gave the relevance of craniofacial structures to obstructive sleep apnea as equivocal association, quantitatively as well as qualitatively. They advocated the need of further standardization for establishing valid definitions for normal sleep, sleep disordered breathing and obstructive sleep apnea syndrome.

Pae, et al. [38] in 1997 described the role of pharyngeal length in Sleep Apnea subjects. Narrow pharyngeal airway was found to be one of the most significant predisposing factor in OSA. Thus accordingly the treatment modalities are focussed on widening the constricted part of pharynx. Joseph AA, et al. [39] in 1998 compared the dimensions of the nasopharynx, oropharynx, and hypopharynx of persons with hyperdivergent and normodivergent facial types and to determine whether any variations exists. Overall the hyperdivergent group had a narrower anteroposterior pharyngeal dimension than the normodivergent control group. Lars Bondemark [40] in 1999 concluded that the change in mandibular position might result in condylar or glenoid fossa remodelling as we as change in the condylar position within the fossa as a compensatory reaction to the advancement of the mandible. To visualise and analyse these changes.

Liu, et al. [41] in 2000 studied the effect of mandibular repositioner devices on airway, sleep and respiratory variables in patients with OSA. With these devices the retropalatal airway space increased and the crossectional area of soft palate and the vertical distances of hyoid bone to the mandibular plane decreased significantly. The tongue posture became more flatter. They found the reduction in Apneiv episodes that was attributed to the effects of the appliance on oropharyngeal structures. Mehra, et al. [42] in 2001 demonestrated the changes in pharyngeal airway after counter clockwise rotation of Maxillomandibular complex by Double-Jaw surgery in patients with high occlusal plane facial morphology. Double-jaw surgery was found to increase the both pharyngeal airway space and significant changes were seen in velopharyngeal anatomy as well.

Tsai HH [43] in 2002 investigated the developmental changes of the hyoid bone position in children from deciduous dentition to early permanent dentition & concluded that without the hyoid bone, maintaining an airway, swallowing, preventing regurgitation and maintaining the upright postural position of the head could not be controlled carefully. Rose, et al. [44] in 2002 investigated the long term efficacy of an Oral Appliance, The Kerwetzky activator, on the respiratory and sleep related parameters in patients with OSA. This appliance was found to be effective in treating OSA but the regular polysomnographic follow-ups were required.

Ringqvist, et al. [45] in 2003 analysed the dental and skeletal side effects of Mandibular Advancement Devices after 4 years of treatment in OSA patients & put forth the importance of considering side effects as ael as beneficial effects of the treatment whether be it Mandibular Advancement ot Uvulopalatopharyngoplasty. Johal, et al. [1] in 2004 showed the maxillary morphology, its constriction and eitiological relation in subjects with OSA. It was found that there is no significant relation between the maxillary morphology and Obstructive Sleep Apnea.

Horiuchi, et al. [7] in 2005 gave the technique for predicting effectiveness of Oral Appliances in OSA subjects. Split-light polysomnography and esophageal pressure were recorded, and cephalometric tracings were superimposed &concluded that evaluation based on Pes and analysis of mandibular displacement expressed by vector resolution using a cephalometric superimposition technique is useful in assessing the efficacy of oral appliances in treating OSA. Sung, et al. [46] in 2006 used the computerised stimulation to describe the role of fluid dynamics in upper airway of OSA patients &concluded that high airflow velocity predominates in medial and ventral nasal airway regions. Maximum air velocity and lowest pressure were observed at the narrowest portion of velopharynx.

Hammond, et al. [47] in 2007 illustrated the dental and skeletal changes as well as the side effects of Mandibular Advancement Splint in OSA subjects. The most common side effects were discomfort, tooth tenderness, excessive salivation and dry mouth and in the same year treatment of OSA patients with Mandibular Distraction Osteogenesis was documented. Jayan B, et al. [48] in 2007 based on linear and angular measurements, compared cephalometric data of 28 Urban Indian Obese (Group I) and 15 urban Indian non obese (Group II) Polysomnography (PSG) diagnosed Obstructive sleep apnea (OSA) adult with 20 age-sex matched controls (Group III) & concluded that predictable cephalometric measurements in OSA patients combined with PSG findings can be employed effectively for diagnosis and treatment planning in our settings They concluded that predictable cephalometric measurements in OSA patients combined with PSG findings can be employed effectively for diagnosis and treatment planning in our settings.

Chen, et al. [49] in 2008 performed three dimentional computer assisted study model to illustrate the effects of long-term use of oral appliances. It was seen that mandibular arch width creased more than maxillary arch width, crowding decreased in both the arches and curve of Speed decreased in the premolar area, mandibular canine to second molar segment moved forward in relation to maxillary arch. Tsai [43] in 2002 demonistrated that the craniofacial skeletal characteristics were found to contribute to OSAS was in the anterior lower portion of the profile in men and in the posterior portion of the profile in females. Zhong Z, et al. [50] in 2010 concluded that the sagittal and vertical skeletal patterns may be contributory factors for the variation of the inferior and superior part of the upper airway, respectively. Skeletal deficiency of nonsnoring Chinese children may predispose them to upper airway obstruction. Jena AK & Duggal R [51] in 2011 in their retrospective study analysed hyoid bone position among subjects with different vertical jaw dysplasias & found that the anteroposterior position of the hyoid bone was more forward in subjects with short face syndrome and the vertical position of the hyoid bone was comparable among subjects with different vertical jaw dysplasias. Axial inclination of the hyoid bone closely followed the axial inclination of the mandible.

Jacobson, et al. [52] in 2012 illustrated surgical procedures as treatment modality in correction of OSA and concluded that the surgery play an important role in treating OSA and is the treatment of choice even in the mild to moderate cases of OSA. They also suggested that a surgeon should always work with the Orthodontist trained in Sleep Medicine, since their combined treatment expertise. Katyal, et al. [53] in 2013 described craniofacial disharmony and upper airway morphology in Pediatric sleep disordered breathing. Children with OSA were found to have increased ANB due to decreased SNB but the direct association was not found of this increased ANB to OSA by Meta Analysis. There is a strong support for reduced upper airway width in children with OSA.

Fastuca, et al. [54] in 2014 described the role of mandibular advancement after rapid maxillary expansion in subjects with OSA and found that no significant differences were evident regarding oropharyngeal airway changes and mandibular displacement after rapid maxillary expansion. Ghodke, et al. [55] in 2014 demonestrated the effect of Twin Block appliance in Class II Div 1 malocclusion cases with OSA. It was found that the depth of oropharynx and hypopharynx was increased significantly. It was concluded that the correction of mandibular retrusion by Twin-Block Appliance in Class II Malocclusion subjects increased pharyngeal airway space

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