Obstructive Sleep Apnea Syndrome: Diagnosis and Management

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Abstract

Increased awareness that changes in sleeping habits and daytime behaviour may be attributable to obstructive sleep apnea syndrome (OSAS) has led many patients to seek both information and definitive treatment. The purpose of this article is to provide information to dentists that will enable them to identify patients who may have OSAS and to assist these patients in making informed decisions regarding treatment options. In patients who have identifiable anatomic abnormalities of the maxilla and mandible resulting in a narrow pharyngeal airway, orthognathic surgery appears to be an excellent treatment option.

MeSH Key Words: *sleep apnea, obstructive/diagnosis; sleep apnea, obstructive/surgery*

This article has been peer reviewed.

An increasing number of people are realizing that changes in their sleeping habits and daytime behaviour may be attributable to obstructive sleep apnea syndrome (OSAS). This new awareness has led many patients to seek both information and definitive treatment. Because the jaws and related structures influence the development of this syndrome, dentists play an important role in both identifying patients who should be assessed by sleep specialists and instituting treatment in selected cases. The purpose of this article is to provide information to dentists that will enable them to identify patients who may have OSAS and to assist these patients in making informed decisions regarding treatment options.

Prevalence

OSAS is characterized by repetitive episodes of upper airway obstruction that occur during sleep usually in association with a reduction in blood oxygen saturation.[1] The prevalence of OSAS in the middle-aged population (30 to 60 years) is 4% in men and 2% in women.[2] However, prevalence rises dramatically with age, to an estimated 28% to 67% for elderly men and 20% to 54% for elderly women.[3]

Clinical Manifestations

The clinical manifestations of OSAS are related to obstruction of the upper airway, fragmented sleep, and the respiratory and cardiovascular consequences of disordered breathing. Excessive daytime somnolence is a key feature of OSAS resulting from disrupted sleep. Patients may report that they frequently fall asleep during the day while driving, working, reading and watching television.[4] Thus, performing activities related to transportation or the use of machinery and heavy equipment can put both the patient and others at significant risk of injury.[5,6] Chronic daytime sleepiness also leads to poor work performance and decreased productivity. Snoring, ranging in severity from mild to extremely loud, is invariably present. The partners of people with OSAS may witness gasping, choking or periods of apnea, with repeated arousals through the night. In many cases these symptoms are significant enough that the partner sleeps in another room. When questioned in the morning the patient is usually unaware of the frequency of arousals. Other complaints include a feeling of not being rested despite a full night of sleep, dry mouth, morning headaches, absence of dreams, fatigue, decreased libido and symptoms of depression.

Figure 1a: *Lateral cephalometric radiograph of a patient with obstructive sleep apnea syndrome (OSAS) indicates the narrow anteroposterior dimension of the pharyngeal airway at the level of the soft palate and the base of tongue (arrows).*

Figure 1b: *Postoperative lateral cephalometric radiograph of the same patient after maxillomandibular advancement. Note the significant increase in the pharyngeal airway space at the level of the soft palate and the base of tongue.*

The respiratory consequences of OSAS are related to the extent of hypoxemia and hypercapnia that develop as a result of the disordered breathing. Advanced cases of OSAS are associated with pulmonary hypertension, corpulmonale, chronic carbon dioxide retention and polycythemia.[7] The cardiovascular consequences of OSAS may include systemic hypertension, cardiac arrhythmias, myocardial infarction, and cerebral vascular accidents, all of which lead to a higher mortality rate than in the general population.[8,9]

Clearly, OSAS can be a debilitating and potentially life-threatening condition. Thus, both proper diagnosis and appropriate treatment are important.

Diagnostic Tools

The dental office can play an important role in screening patients who may have OSAS by including 2 questions on the medical questionnaire: Do you snore loudly? Do you have difficulty staying awake when you are inactive (e.g., while reading, watching television or driving)? A positive response to these 2 questions should lead the dentist to suspect OSAS. Additional questions should then be asked to help identify the extent of the problem: Has your partner witnessed pauses in your breathing while you are asleep? Have you fallen asleep in a potentially dangerous situation? Has your work performance suffered? Has your concentration, memory or mood been affected?

If the history supports the diagnosis of OSAS, the patient should be referred to a sleep disorders laboratory for overnight polysomnography, the objective method of establishing the diagnosis and assessing the potential success of treatment. The most important variables used in determining the presence and severity of OSAS are the apnea index, the hypopnea index, the respiratory disturbance index (RDI) and the lowest oxyhemoglobin saturation.[10] Apnea is defined as cessation in air flow for 10 seconds or more, and the apnea index is the number of apneic episodes occurring in a 1-hour period.[11] Hypopnea has been defined as a 50% reduction in tidal volume for more than 10 seconds, and the hypopnea index is the number of hypopneic episodes in a 1-hour period.[11] The RDI is defined as the number of apneic and hypopneic episodes per hour of sleep.[11] The lowest oxyhemoglobin saturation is simply the lowest oxygen saturation measured by pulse oximetry during the study. OSAS is diagnosed if the RDI reaches a certain threshold level, typically 5 or 10.[3,11] OSAS becomes clinically significant when the RDI is greater than 20 and oxygen desaturation events fall to a level below 80% to 85%.[12]

Causes

Obstructive sleep apnea can be caused by an anatomic abnormality that narrows or obstructs the airway. Investigations to localize the site of functional obstruction in the upper airway have shown that there is rarely a single site of occlusion. Obstruction more commonly occurs at multiple levels of the upper airway during episodes of hypopnea and apnea[13] (**Figs. 1a, 1b**).

Figure 2: *Preoperative photograph of the patient depicted in* ***Figure 1****. Patients without a clinically obvious facial deformity may benefit from maxillomandibular advancement. As this photograph indicates, patients with OSAS may not be obese.*

Figure 3: *Lateral cephalometric radiograph of a patient with OSAS who underwent uvulopalatopharyngoplasty demonstrates a thick, bulbous soft palate (arrow) associated with a narrow nasopharyngeal airway.*

In any patient, upper airway patency is maintained through many interrelated anatomic and physiologic factors.[14] Normally, negative intrapharyngeal pressure develops during inspiration. Collapse of the airway is prevented by the action of the pharyngeal abductor and dilator muscles. The pharynx consists of 3 segments: the nasopharynx, the oropharynx and the hypopharynx. The muscles become hypotonic during sleep, and airway stability becomes dependent on pharyngeal size and pharyngeal tissue compliance in these 3 segments.[14,15] If the compliance of the soft tissues in the narrowed segments of the passive airway is inadequate to offset the negative intraluminal pressure created during inspiration, airway obstruction occurs. As a result, the central nervous system adjusts to a lighter level of sleep by increasing muscle tone to allow opening of the airway and resumption of the breathing cycle.

Once the diagnosis of OSAS has been confirmed but before treatment is instituted, upper airway imaging is often performed to obtain additional information regarding the anatomy of the airway. For example, clinical examination does not always reveal a gross facial deformity (**Fig. 2**), but cephalometric radiography can help in determining the anatomic factors contributing to OSAS. This information can then be used to direct treatment, particularly surgery, and may lead to more predictable treatment outcomes. Studies involving cephalometric radiography in patients with OSAS have demonstrated that these patients have smaller retropositioned mandibles, narrower posterior airway spaces, and larger tongues and soft palates than control patients, as well as inferiorly positioned hyoid bones and retropositioned maxillae.[16]

Management

OSAS can be managed nonsurgically or surgically. The treatment should target the potential contributing factors identified by the history, the physical examination and upper airway imaging. The severity of the patient's condition must also be considered in developing a treatment plan.

Nonsurgical Management

Because obesity is a risk factor for OSAS, a reduction in body weight can reduce sleep apnea.[17,18] However, the patient may have difficulty losing weight, particularly in more severe cases, because excessive daytime somnolence and fatigue may discourage the patient from exercising. The severity of the OSAS may have to be reduced through some other form of treatment before an exercise program can be started. It is important to note, however, that many patients with OSAS are not obese (**Fig. 2**).

The most successful nonsurgical treatment is continuous positive airway pressure (CPAP). The use of CPAP in the treatment of OSAS was first described in 1981.[19] Since then it has become the gold standard in the treatment of this condition.[10] However, because of physical discomfort associated with wearing the unit, drying of the nasal and oral mucosal membranes, dislodgement during sleep, noise and the social consequences of using the unit, compliance may be as low as 46%.[20]

Oral appliances can also be used in the treatment of OSAS.[21] A review of 20 studies, involving a total of 304 patients, revealed that oral appliances were effective in 51% of cases, as defined by achievement of an RDI of less than 10.[22] In 2 studies that compared oral appliances for mandibular advancement with CPAP, the oral appliances were effective in mild to moderate cases but were less effective than nasal CPAP in more severe cases.[23,24] In both these studies the patients strongly preferred the oral appliance over nasal CPAP for reasons of comfort. The most significant negative long-term effects of oral appliances are temporomandibular joint problems and movement of teeth.[25-27] Tooth movements may result in a posterior open bite and decreased anterior overjet.[21]

Other nonsurgical treatments for OSAS include medications such as protriptyline and medroxyprogesterone. Protriptyline, a tricyclic antidepressant, has shown reasonable symptomatic improvement of OSAS and may reduce the degree of oxygen desaturation, but anticholinergic side effects and incomplete efficacy limit its use.[7] Medroxyprogesterone has limited value in the treatment of OSAS but it may be effective in cases of obesity hypoventilation syndrome with chronic hypercapnia.[7]

Surgical Management

Tracheostomy was the first successful surgical treatment for OSAS. It was introduced for this purpose in the 1970s.[28] This procedure, which bypasses the upper airway, is successful in virtually 100% of cases.[29] Complications associated with tracheostomy include hemorrhage, recurrent infections, airway granulations, and tracheal or stomal stenosis.[29] The medical and obvious social problems associated with tracheostomy have stimulated the search for alternatives.[7]

Fujita and others[30] first described the use of the uvulopalatopharyngoplasty (UPPP) for the treatment of OSAS in 1981. This procedure involves shortening the soft palate, amputating the uvula, and removing redundant lateral and posterior pharyngeal wall mucosa from the oral pharynx. Despite the popularity of this procedure, reviews have reported improvement in less than 50% of patients and complete control of OSAS in 25% or less.[31,32] Postoperative lateral cephalometric radiographs of patients who have undergone UPPP and whose symptoms persist reveal that the soft palate has been shortened but is much thicker, which results in a narrow nasopharyngeal airway (**Fig. 3**). The unsatisfactory results obtained with UPPP have contributed to the realization that there are usually multiple sites of obstruction in the upper airway. When patients are selected on the basis of retropalatal obstruction demonstrated by computed tomography during wakefulness or by catheter measurements of nasal pharyngeal pressure, the success rate of UPPP is only 50%.[16]

UPPP also carries a risk of significant hemorrhage, and patients report substantial postoperative pain, which may last for an extended period. Velopharyngeal insufficiency and nasophyaryngeal stenosis may also complicate UPPP.[10]

Use of orthognathic surgery to treat OSAS began toward the end of the 1970s, when mandibular advancement was reported to have reversed the symptoms of OSAS.[33,34] Since then, this procedure has become widely accepted.[11,35-42] Orthognathic treatment for OSAS may involve advancement of the maxilla, mandible or chin (**Fig. 4**). These 3 procedures can be performed in any combination, but advancement of the maxilla and the mandible, with or without advancement genioplasty, is the most common procedure. The treatment plan is based on craniofacial cephalometric analysis, which determines whether the position of the maxilla, mandible and chin are normal or abnormal. The architectural and structural craniofacial analysis of Delaire[43] allows precise planning of the surgical advancement to maximize the increase in pharyngeal dimensions while maintaining normal facial balance.

Hochban and others[35] reported a series of 38 consecutive patients with OSAS treated by 10 mm maxillomandibular advancement. Patients were selected on the basis of the results of lateral cephalometric radiography; those who had pharyngeal narrowing, with or without retrognathic mandibles, were offered the procedure. Polysomnographic sleep studies were performed preoperatively and 2 months after surgery. In 37 of the 38 patients, postoperative RDI was reduced to below 10.

Waite and others[44] performed maxillomandibular advancement in 23 patients with obstructive sleep apnea. All of the patients had preoperative RDI of greater than 20 and some form of craniofacial deformity. Adjunctive procedures such as partial turbinectomy, septal reconstruction and advancement genioplasty were also performed, depending on individual variation. Sleep studies were performed and lateral cephalometric measurements obtained 1 and 6 weeks after surgery. Surgical success, defined as RDI of less than 10, was 65%, although 96% of the patients showed both subjective and objective improvement.

Goodday and others[45] compared preoperative and postoperative cephalometric radiographs in 25 consecutive patients who had undergone orthognathic surgery for the treatment of OSAS. The median increase in the distance between the posterior pharyngeal wall and the soft palate was 100%. Similarly, the median increase in the distance between the posterior pharyngeal wall and the base of tongue was 81%. These findings help explain why selected patients experience improvement after orthognathic surgery.

Robertson and others[46] studied subjective outcomes after maxillomandibular advancement for the treatment of OSAS. Twenty-four patients completed a questionnaire a mean of 24 months after surgery. They reported an

Figure 4a: *Preoperative photograph of a patient with OSAS.*

Figure 4b: *Postoperative photograph of the same patient 6 months after maxillomandibular advancement.*

Figure 4c: *Preoperative lateral cephalometric radiograph of the same patient shows the narrow pharyngeal airway space.*

Figure 4d: *Lateral cephalometric radiograph of the same patient after maxillomandibular advancement shows significant improvement in the pharyngeal airway space.*

improvement in daytime sleepiness from the levels seen in patients with severe OSAS to levels similar to those seen in normal controls. Statistically significant reductions were observed in the number of patients reporting problems with memory, concentration and stress. Of patients who snored preoperatively, 45% stopped snoring and 45% reported a reduction in snoring severity.

Compliance is not a factor in the success of orthognathic surgery as it is for CPAP and oral appliances. Relative to tracheostomy and CPAP, orthognathic surgery is more socially accepted. It is also more successful in treating severe OSAS than UPPP and oral appliances. Recent studies have demonstrated significant improvements in OSAS symptoms in patients who have undergone orthognathic surgery, and this procedure is associated with a high level of patient satisfaction and low risk.[47]

Conclusions

OSAS is a common condition associated with significant morbidity and mortality. It is therefore important that dental professionals be aware of the signs and symptoms of OSAS, so that the diagnosis can be confirmed and treatment initiated as soon as possible. As knowledge about the pathophysiology of OSAS improves, treatments may be designed to address the specific causes of the condition. In patients with identifiable anatomic abnormalities of the maxilla and mandible resulting in a narrow pharyngeal airway, orthognathic surgery appears to be an excellent treatment option. ◆

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The authors have no declared financial interest.

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