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Review Article

Role of the oral health professional in obstructive sleep apnea

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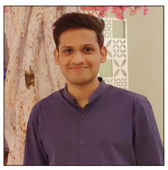

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ABSTRACT

American Academy of Sleep Medicine (AASM) describes obstructive sleep apnea (OSA) as a sleep-related breathing disorder that involves a decrease or complete halt in airflow despite an ongoing effort to breathe. This causes multiple episodes of hyperarousal or wakefulness from sleep, which leads to a decrease in the quality of sleep, leading to daytime sleepiness, increased affinity to accidents, and cardiovascular diseases such as myocardial infarction, congestive heart failure, and stroke. It is measured using the apnea-hypopnea index, that is, the number of sleep arousals in a given night. Possible risk factors for the disease include obesity (body mass index of ≥30), older age, Down's syndrome, family history of OSA, and abnormal craniofacial features. Treatment options include continuous positive airway pressure, weight loss, oral devices, surgeries of the soft palate and/or genioglossus muscle, and maxilla-mandibular advancements. This review aims to address the oral diagnosis and dental treatment of OSA.

Keywords: Obstructive sleep apnea (OSA), Oral devices, Dental management, Mandibular advancements, Oral surgical procedures

INTRODUCTION

Obstructive sleep apnea (OSA) is a complex disorder of the upper airway that causes multiple episodes of wakefulness due to lack of oxygen to the brain, which alerts the body to re-establish a normal pattern of respiratory rhythm while sleeping, leading to a decrease in the quality of sleep. Chronic sleep disturbance leads to decreased alertness and responsiveness to other humans and complex cardiovascular disorders such as systemic hypertension, diabetes mellitus type 2, myocardial infarction, stroke, and congestive heart failure.[1] The global prevalence of OSA reported by Benjafield *et al.,* according to the American Academy of Sleep Medicine (AASM) diagnostic criteria of 2012 is estimated to be 936 million adults (men and women) aged 30–69 years who have at least mild to moderate OSA and is highly prevalent in countries such as China as well as the United States, Brazil, and India.[2] This literature review aims to clearly understand the crucial role that the dental health professional can partake in the successful dental management of the patients suffering from this disorder. A literature search was conducted using online resources such as PubMed, Scopus, Google Scholar, DOAJ, Biomed Central, and Semantic Scholar; out of 300 articles that were reviewed, 96 were found relevant to the objective of this study, that is, oral diagnosis and the dental management of OSA. Oral health professionals (OHPs) deal with craniofacial abnormalities on a daily basis, and since a substantial part of patients suffering from OSA are highly undiagnosed; therefore, OHPs can play an integral role in timely oral diagnosis and providing suitable dental and oral surgical treatment options for the patient.

The AASM classifies OSA according to the apnea-hypopnea index (AHI), which is the number of apneas and hypopneas per hour in a full night's sleep as:

1. Mild OSA (AHI of 5–15)
2. Moderate OSA (AHI of 15–30)
3. Severe OSA (AHI>30).

CRANIOFACIAL FEATURES ASSOCIATED WITH OSA

Apart from OSA being more prevalent in populations that are obese, ethnicity (Chinese and Hispanic), and male gender,[3-5] a very important fact is the differences in craniofacial structures that predispose these patients to OSA.[6-8] In the non-obese population, factors such as narrowing of the nasopharynx and oropharynx as well as enlargement of soft tissue in the upper airway are important risk factors such as:

1. Shorter maxillary length and height
2. Shorter mandible
3. Retrognathic mandible
4. Increased anterior lower facial height and mandibular plane angle
5. Enlarged soft palate
6. Anterior displacement of the hyoid bone
7. Retroposition of the mandible
8. Enlarged tongue
9. Brachycephalic head form (a wider and shorter facial form).

In addition, the following cephalometric measurements are firmly suggested to be correlated to OSA

- Shorter cranial base angle
- Decreased cranial base length
- Increased thyromental angle[9]
- Increased mandibular rotation
- Decreased posterior facial height
- Increased anterior facial height
- Inferiorly and posteriorly positioned hyoid bone.

OSA might be an overlooked problem in patients with genetic syndromes since both medical and dental professionals and maxillofacial surgeons are involved in the management of these disorders, but this should be addressed appropriately, diagnosed timely, and treated promptly by both the specialties playing their crucial roles;

Certain syndromes that the dentist might encounter that lead to OSA can be

1. Neurofibromatosis type-1 involves the gingivodental structures as well as craniofacial structures.[10]
2. Hemifacial microsomia (hypoplasia of the zygomatic, maxillary and mandibular bones as well as facial structures)[11]
3. Treacher Collins syndrome (malar hypoplasia, facial asymmetry, and mandibular hypoplasia)[12]
4. Möebius syndrome (persistent micrognathia and microsomia from birth)[13,14]
5. Kallmann syndrome (extreme maxillary and mandibular retrognathia with increased angle of the mandible)[15]
6. Pierre robin sequence (mandibular macrognathia, glossoptosis of the tongue, and cleft palate)[16]
7. Smith-Lemli-Opitz syndrome (micrognathia, small chin, small nose, and microcephaly)[17]
8. Stickler syndrome (Midfacial underdevelopment and mandibular micrognathia)[18]
9. Beckwith-Wiedemann syndrome (BWS) (Macroglossia is seen in about 90% of patients with BWS)[19]
10. Turner's syndrome (mandibular retroposition, wide gonion angle, and relatively increased lower facial height)[20]

DENTAL AND ORAL SURGICAL MANAGEMENT OF OSA

Treatment is indicated according to the severity risk of OSA in the patient; the fundamental step in the treatment plan is patient education and counseling about the severity and risk of the disease if left untreated. OSA patients who do not get satisfactory relief from continuous positive airway pressure (CPAP) behavior therapy and other treatment options that fall under the realm of being treated by an OHP.

According to AASM parameters, oral appliances (OAs) are more preferred than CPAP in most patients[21] and have generally a higher compliance[22] and success rate due to their ease of use and simple design. OAs are devices whose primary intention is to protrude the mandible, thereby maintaining the patency of the airway during sleep. These are fabricated by a specialist who has experience in dealing with OSA patients because OSA patients that use an OA require regular follow-ups and evaluations, and thus, the dentist must be reliable in the long term.[23] OAs have increased compliance by the patients and offer long-term relief to the patient in terms of a decrease in night-time snoring, improvements in respiratory variables, and daytime somnolence in mild-to-moderate AHI patients.[22,24,25] OAs function by making increments of mandibular advancements up to 1 mm with a protrusive range of up to 5 mm; Iftikhar, in an systematic review and meta analysis (SRMA), reported a reduction of 2mm of systolic, diastolic, and mean arterial pressure noted among 399 meeting the inclusion criteria;[26] multiple studies have demonstrated that OAs lead to improved cardiovascular function at night and also reduce hypertension.[27,28] When compared to polysomnography (PSG) parameters, daytime somnolence, cardiovascular function, quality of life measures, and neurobehavioral functions, OAs have demonstrated similar efficacy to CPAP.[29-31] Tongue retention devices work by producing suction to displace the tongue during sleep anteriorly and can be the only appliance that can be used in completely edentulous patients and patients who cannot have dental implants[32,33] when comparing tongue retention devices to mandibular advancement devices, which work basically on producing reversible protrusion of mandible, majority of the patients reported tongue retention devices to be rather uncomfortable and preferred mandibular advancement splint over tongue retention device.[34] Non-adjustable mandibular advancement devices engage most maxillary and mandibular arches but are fabricated on a fixed level of protrusion for the duration of the treatment and, hence, are deemed uncomfortable compared to adjustable mandibular advancement devices; therefore, due to lack of randomized control trials and high-quality evidence, the consensus on OA of American academy of dental sleep medicine recommends the custom-fabricated adjustable OA to be of comparatively greater efficacy, greater patient acceptance, greater range of protrusive movement, and recommends them for general use in clinical practice.[35-37] Multiple studies suggested that the efficacy of OAs depends on the degree of protrusion of the mandible and is also dose-dependent on the degree of protrusion of the mandible.[25,38]

A twin block appliance is used to correct mandibular retrognathism in patients with no obesity or tonsillar hypertrophy, and the results were measured according to PSG and cephalometric parameters and obtained that timely interventions using an orthodontic appliance in pediatric patients suffering from OSA have a significant impact on the defined parameters as well as aids in substantial opening of the upper airway and an improved facial profile.[39] Pirelli *et al.,* performed a 12-year study on the effect of long-term rapid maxillary expander on pediatric patients with isolated maxillary narrowing as well as the absence of tonsil hypertrophy and found the results to be encouraging, leading to stable long-term results in OSA measured repeatedly over time using PSG.[40] Microimplant-based mandibular advancement is also an alternative procedure used by orthodontists to treat OSA using skeletal anchorage to advance the mandible with micro-implants and yields statistically significant and affirming results in terms of >50% reduction in AHI values, also offering a significant reduction in time and frequency of snoring.[41]

Earlier tonsillectomy was reserved as a treatment option for patients having recurrent tonsil infection, but a considerable body of evidence and studies have suggested tonsillectomy as a treatment for adult OSA patients that suggest palatine tonsillectomy as an effective treatment for patients with tonsillar hypertrophy as a major etiology for OSA.[42-44] Uvulopalatopharyngoplasty (UPPP) is based on partial resection of the tissue of the uvula and soft palate, that is a tonsillectomy, in addition to trimming the edge of the soft palate and uvula with suture closure. There have been a number of studies suggesting the efficacy of UPPP in multiple SRMAs[45-47], and some studies have found UPPP to be up to a 50% reduction in the AHI index.[45-47] A study by Halle *et al.,* also suggests that UPPP reduces cardiovascular risk as well as mortality.[48] UPPP can be a standard one, which was first described in 1981 by Fujita but resulted in post-operative complications such as UA edema, postoperative bleeding, velopharyngeal insufficiency, and nasal regurgitation. Modifications to the standard were made, namely, submucosal UPPP, extended UPPP, and uvulopalatal flap UPPP. These modifications have better efficacy than standard and minimal side effects with an overall complication rate of up to 2–8%.[47,49]

Radiofrequency palatoplasty is mainly used for mild cases of OSA involves using radiofrequency delivered to the soft palate through an electrode with precision which allows us to ablate a very limited amount of tissue which was causing snoring and related OSA; this procedure has limited evidence and has studies with a small target population and offers relief in the short term;[50] due to the non-invasive nature of the procedure, it can be performed in an outpatient setting too.[51] Long-term relief can be attained if the procedure is performed at multiple intervals over the years.[52,53] Palate pillar implants are placed in the soft palate in an attempt to increase the rigidity of the soft palate and extend the hard palate; this process leads to the formation of a hard, fibrous capsule in the soft palate, which has been reported to cause reductions in snoring and vibration of the soft palate from retropalatal collapse, it is not recommended as a sole treatment option but as a part of multimodal treatment of OSA.[54,55] This procedure is done as an office procedure in an outpatient setting. In suture suspension technique, the mobile tissues of the soft palate and lateral wall of the pharynx are tied by trans-mucosal introduction with the assistance of permanent sutures, leading to modifications in the fibromuscular tissues as required. According to drug induced sleep endoscopy (DISE) parameters, patients with retropalatal and lateral pharyngeal wall collapse are indicated for this procedure. This not only lifts the palate and the valvular complex but also leads to the widening of the nasopharyngeal space. Several techniques have been proposed to achieve this outcome, namely, barbed reposition pharyngoplasty,[56] barbed roman blinds technique,[57] barbed suspension pharyngoplasty,[26] and barbed expansion sphincter pharyngoplasty (ESP).[58]

Radiofrequency linguoplasty is recommended as an adjuvant treatment along with other measures and is offered only in selected patients with mild to moderate OSA. It uses radiofrequency-based ablation of the base of the tongue, and the underlying mechanism of effectiveness is by scar formation in the submucosal tissues[59] first described by Powell *et al*.,[60] although tongue base radiofrequency (TBRF) ablation is an effective procedure in patients with mild OSA[61] by no means should it be relied on as a solitary procedure for patients with OSA but is recommended by some authors as part of an amalgamation of treatment options such as UPPP[62] and reported a superior AHI reduction by adding TBRF. Maxillary expansion is indicated for patients who have anatomical deficiencies in the craniofacial complex leading to OSA and/or adult patients with severe OSA due to maxillary deficiency. The non-surgical version of this procedure is rapid maxillary expansion (RME), which is done in the office setting by an orthodontist, but RME can be ineffective in many patients, deeming them to go for surgical expansion of the maxilla. The underlying mechanism is to transverse expansion of both halves of the maxilla at the point of the median palatal suture, thereby increasing the alveolar half and length of the maxilla. This also offers benefits such as increased airway dimensions and improved breathing, increased palatal width, and oral cavity volume.[63,64] RME is effective in reducing the AHI.[65,66] Other procedures to expand the maxilla are Surgically Assisted Rapid Palatal Expansion (SARPE) and Distraction Osteogenesis Maxillary Expansion (DOME); these techniques use micro implant-based expanders, which are surgically implanted in both the palatal shelves initially activated by the surgeon at the time of surgery and then later on adjusted by the orthodontist at repeated intervals.[67] The benefits offered by SARPE and DOME are successful transverse expansion of the maxilla and surrounding structures in patients that are skeletally mature and also greater transverse expansion of the maxilla due to surgical intervention. In addition, it reduces refractory nasal obstruction in daytime somnolence and increases the percentage of REM sleep.[67] Various combinations of techniques of SARPE are, namely, maxillary, pterygopalatine lateral nasal, septal, and palatine osteotomies according to the location of the resistance to expansion. SARPE leads to a 50–70% reduction in AHI values RDI reduction of up to 50% in patients with no tonsillar hypertrophy or in patients who have undergone T and A procedures.[66-70]

Maxillomandibular advancement (MMA) has been performed since the 1980s for OSA and is considered an option in cases to correct anatomic deficiencies that compromise other therapies or to enhance the efficacy of other modalities. It is considered an option in patients with any degree of OSA but is mainly indicated in cases of mandibular insufficiency, circumferential velum, and lateral oropharyngeal wall collapse. Using MMA, the maxilla and mandible are advanced up to 8–14 mm[71] following osteotomy. It has the best overall success rate in OSA patients due to non-reliance on patient compliance and is underutilized in OSA treatment. In a meta-analysis done by Holty *et al.,* on 22 studies reports that post-MMA, the mean AHI decreased from 63.9/h to 9/h, and surgical success rates calculated according to a random-effects model were found to be 86% with a cure rate of 43.2% that is AHI<5. The major predictors of MMA success were younger individuals with no obesity and lower AHI values.[72] MMA also has a decent effect on improving quality of life measures, daytime somnolence, with reductions in ESS, as well as blood pressure 6 months after surgery.[73,74] There is a lack of evidence on reports of major side effects from MMA, but some studies have shown the major complications rate to be up to 1% (airway compromise)[72] and persistent nasal obstruction rates up to 18.6%.[46] Riley *et al.,* first demonstrated genioglossus advancement in 1984 in a 24-year-old woman with OSA due to retrolingual obstruction to the airway and successfully treated the patient[75]. Since then, this procedure has been implemented in many OSA patients. The surgical efficacy is not precisely known due to a lack of homogeneity among authors regarding the patient parameters required to undergo GA. Riley *et al.,* and Foltan *et al.,* report a 60% and 74% surgical success rate, respectively[76-78], with significantly improved AHI. Due to lack of evidence, this procedure should be used as an adjunctive procedure and an early intervention for OSA procedure.

CONCLUSION

While OHPs were not considered the most reliable people for diagnosis and management of OSA but in a significant minority of patients, the OHP might be the first-contact healthcare provider to encounter OSA; therefore, this role has evolved over the years, with the advent of dental sleep medicine, a knowledgeable dentist can make a timely oral diagnosis, provide dental or oral surgical treatment of oral-craniofacial factors, and if needed provide adequate timely referral to a specialist, which will save the patient from the chronic consequences of OSA and, thus, contribute to reducing the overall disease burden of OSA.

Ethical approval

The Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent was not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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