Review Article

Prosthodontic Management in Sleep Apnea – A Review

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Abstract

Background: Obstructive sleep apnea (OSA) can be defined as common condition characterized by repeated episodes of nocturnal apnea due to upper airway blockage. OSA causes severe symptoms, such as excessive daytime sleepiness, and is associated with significant cardiovascular abnormalities. At present, there are different treatment options for effective management of this disease. More than three decades after use, continuous positive airway pressure (CPAP) is still considered as the gold standard treatment. Nasal CPAP is very effective in controlling symptoms, improving quality of life, and reducing the clinical sequelae of sleep apnea. Other modalities for positive airway pressure are available for patients with CPAP intolerance or high over pressure. Mandibular advancement devices, particularly if custom made, are effective in mild-to-moderate OSA and provide a viable alternative for CPAP intolerant patients. The role of surgery remains doubtful. Uvulopalatopharyngoplasty is a well-established procedure and can be considered when CPAP treatment has failed, whereas maxillary-mandibular surgery may be suggested to patients with a craniofacial deformity. Minimally invasive methods of treating snoring are gaining trends. Weight loss improves symptoms and morbidity in all obese patients and bariatric surgery is an option in severe obesity. A multidisciplinary approach is necessary for an accurate management of the disease.

Keywords: Obstructive sleep apnea, Continuous positive airway pressure, Nasal continuous positive airway pressure.

Introduction

Main cause of obstructive sleep apnea (OSA) can be complete or partial blockage of the airway due to the collapse of the soft tissue in the pharynx. It is a major medical problem affecting up to 4% of middle-aged adults.[1] The prevalence increases dramatically with age, to an estimated 28–67% for elderly men and 20–54% for older women.[2] The most common complaints are loud snoring, difficulty sleeping, and excessive daytime sleepiness. Patients with apnea may develop cardiovascular malfunctions, such as coronary heart disease, hypertension, and stroke, because of the recurrent nocturnal hypoxemia and hypercapnia.[3] Obstruction of airway can occur in many areas of the nasopharynx, oropharynx, and hypopharynx.[4] Airway obstruction occurs in the oropharynx is more common.[4] Redundant peripheral pharyngeal tissue reduces the size of the posterior airway, increasing the possibility of obstruction during sleep.[5] Sleep apnea can be categorized by the number of events per hour from mild to severe according to events/hour: [6] Anatomic and static clinical findings were the first parameters to be evaluated to improve treatment success. Friedman *et al*. developed a clinical 4° staging system incorporating the tonsil size, the position of the soft palate, the tongue size, and the body mass index.[7] An evaluation of size of the tongue, presence and size of tonsil, opening of oral and nasal airways, and the size of the neck can raise concerns on the patency of airway. The presence of tooth wear and temporomandibular joints (TMJ) symptoms is important, as they play a role in OSA.[7]

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Discussion

Investigation

Lateral cephalograms

It shows reduction in minimal palatal airway widths, increased soft palate thickness, differences in calculated craniofacial scores, increased pharyngeal lengths, retroposition of the mandible or the maxilla, micrognathia, increased mean facial heights, and differences in position of hyoid bone.

Computed tomography (CT) scanning

Compared to lateral X-ray cephalometry, soft-tissue contrast is enhanced in CT scanning and enables accurate measurements of cross-sectional areas at different levels,

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as well as three-dimensional reconstruction and volumetric evaluation.

Magnetic resonance imaging (MRI)

MRI offers various advantages, such as excellent three-dimensional assessments of soft tissue, contrast of tissue structures, and lack of ionizing radiation. Numerous authors have demonstrated the mechanism and extent of airway obstruction by MRI can also be visualized, during natural sleep.[8]

Videoendoscopy during spontaneous sleep

Videoendoscopy during spontaneous sleep allows the assessment of the upper airway during different stages of sleep and it lacks the side effects of sedative drugs, this method can be seen as superior to videoendoscopy under sedation.[9]

Acoustic reflection test

This test can be used to determine the airway obstruction and the effect of mandibular advancement and protrusion on the upper airway.[10] In this test, the sound wave is projected into the airway and is reflected back through the tube to a computer that creates a diagram that determines the location of the obstruction.

Objective testing

Two methods of objective testing are in laboratory

1. Polysomnography and
2. Home testing with portable monitors.[7]

Treatment Protocol

The management protocol includes behavioral modifications, sleep position change, and weight control by modification in daily life. Various modalities of treatment for treating OSA include continuous positive airway pressure (CPAP), surgery to widen upper airway, and orthognathic surgery for bringing the mandible and maxillae forward and oral appliances. Complete dentures for edentulous patients help restore vertical face height and control on the lower jaw, thereby helping in normal breathing.[11]

Behavior modification

Educational and behavioral interventions are the first step in approaching patients with OSA, independently from the treatment chosen. Patients should avoid risk factors such as smoking, drinking alcohol (particularly in the evening), using sedatives, and hypnotics. The physician should explain patients the role that obesity plays in their disorder, and should be advised to maintain an optimal weight. Intensive lifestyle interventions are effective in the management of OSA, resulting in significant weight loss and a reduction in sleep apnea severity.[12] Recent data suggest that a supportive intervention can significantly increase compliance in patients with moderate-to-severe OSA.[13]

Positive airway pressure (PAP) treatment

PAP devices function as a pneumatic support that allows the patency of upper airway to be maintained by increasing the upper airway pressure above a "critical" value (pressure value below which the respiratory tract). The device is attached to nasal or oronasal mask which is applied to the patient, overnight or during night at a set positive pressure. Various degrees of severity of OSA determine the pressure to be applied and higher pressures are needed to abolish those apneas that occur during sleep of rapid eye movements, in a supine position or in the presence of severe obesity.

If the apnea hypopnea index (AHI) is above 5 and below 15, PAP is displayed if symptoms are present (i.e. sleepiness, impaired cognition, and mood disorders) or in the presence of hypertension, coronary artery disease, or previous cerebrovascular accidents.

CPAP

CPAP uses a machine to help a person who has OSA breathe easier during sleep. A CPAP machine increases air pressure in your throat so that the airway does not collapse when we breathe in and can be used at home every night while we sleep.

Other and newer modalities of PAP ventilation

Different modalities of PAP ventilation have been utilized to treat OSA where high level of pressure is required to treat OSA. Bilevel PAP ventilation provides two different pressure levels (higher on inhalation and lower on expiration) and can treat OSA at a lower mean pressure than CPAP, at the same time improving lung ventilation through a pressure support. CPAP failure can occur due to severe obesity and impaired awake blood gas values.[14] In these patients, adequate control of OSA and an improvement in awake blood gas values can be achieved using bilevel PAP.[15] Treatment with bilevel PAP is also preferred in patients with severe OSA and in those requiring high treatment pressures.[14]

While CPAP delivers a continuous fixed pressure during the entire treatment session, auto-CPAP works by automatically and continuously adjusting the delivered pressure (within a maximal and minimal value, set by the operator) to maintain upper airway patency following changes in airflow resistance.[16] Auto-titrating CPAP (auto-CPAP) is a more sophisticated device providing an alternative to traditional CPAP.

Alternatives to PAP positional therapy

Due to anatomical and physiological mechanisms, the body position during sleep influences the frequency and the severity of the obstructive events. The supine position, mainly due to the effect of the gravity on tongue and soft palate position, is generally associated with an increased number of apneas/hypopneas.[17] Postural OSA is diagnosed when the obstructive events occur exclusively or primarily in the supine posture (the AHI in the supine position is at least double with respect to the non-supine position) and it occurs approximately in 30% of the patients with OSA.[18]

Various positional therapies include the simple "tennis ball technique," consisting of a tennis ball tied behind the back to discourage supine position, supine alarm devices, and various positional pillows.[19,20]

Surgical procedures

Various treatment options have been searched and the role of surgery in management of OSA has been found to be definitive. Oropharyngeal tract and nose are the most common sites of obstruction.[20] As airway obstruction can occur at different location, different levels of surgery exist, including minimal invasive techniques (under local anesthesia as an outpatient procedure) and more invasive procedures. Surgery can be performed at the level of the nose, oropharynx tract, tongue, and craniofacial structures.

Prosthodontic Management

Oral appliances

Mandibular advanced splints are the most commonly used oral appliance. These appliances are indicated for use in patients with primary snoring, mild and moderate OSA, and who do not respond or are inappropriate candidates for treatment with behavioral practices such as weight loss or sleep position change.[7]

Monoblock appliances

It was developed by Pierre Robin in 1902. Monoblock appliance is a single vulcanite bite jumping appliance which was used to position the mandible forward in patients with Class II malocclusion due to mandibular deficiency.

Activator

This removable appliance was developed by Andresen in 1908 and subsequently popularized as the Andresen–Häupl appliance. It is a bulky appliance, with acrylic blocks covering the palate and both arches. Furthermore, it was constructed to hold the mandible in a protrusive position or to cause the mandible to occlude in a protrusive position.

Bionator

Wilhelm Balters has developed activators of reduced bulk, known as bionators. The upper and lower components of bionator were connected by a wire, facilitating incremental activation.

Karwetzky activator

Karwetzky activator is a tooth- and tissue-borne activator which is split along the occlusal plane and joined by two "U" loops made of 0.9 mm stainless steel wire in the lingual acrylic area of first molars. Lateral and vertical jaw movements during sleep are possible with this design. This appliance can be easily made in a dental laboratory.

Twin block appliance

It was first developed by William Clark in 1977. Originally, it was made of acrylic blocks cut at 45° to the occlusal plane; this has since been modified to 70 degrees to provide better engagement of the blocks and more positive forward positioning.

Soft palate and uvula lifting appliance

The prosthesis lifts and/or stabilizes the soft palate, preventing vibration during sleep. It can be used in cases where soft palate is incompetent and is the cause for snoring, as it enables lifting of the soft palate. Uvula lifting appliance can be used in cases where elongated or bifid uvula was the cause for upper airway obstruction.

Tongue retention

An alternative oral appliance treatment is using the tongue stabilizing device (TSD) for snoring and sleep apnea. The TSD was first described in 1982. It's a small piece of plastic that sits on your lips and resembles a large pacifier with a hole into which you can insert your tongue. When used, it can hold your tongue forward, which could relieve snoring or sleep apnea that occurs with clogged airway.[21]

These devices have a cavity in the anterior part of the device that places the tongue in a more forward position, increasing the distance between it and the posterior pharyngeal wall. It incorporates an anterior hollow bulb, which generates a negative pressure vacuum when the tongue is inserted.

Mandibular advancement devices (MADs)

It is the one with fixed mandibular advancement or titratable/adjustable mandibular advancement appliances.

Mandible repositioning appliance

Appliances for repositioning the mandible represent the most useful design in the range of oral appliances. Their mechanism of action is to anteriorly reposition the mandible and indirectly reposition the tongue, with the aim of expanding the size of the upper airway during sleep.

It holds the mandible in an antero inferior position, which indirectly brings the tongue forward opening up the posterior airway.[22]

Mouth protectors

A custom mouth guard is a device made by a dentist to help reduce snoring and relieve OSA. Other designs of custom mouth guards may protect your teeth from grinding or clenching while you sleep or from sports injuries, but they do not have the same function as those that help you breathe during sleep.

Mandibular advancement and tongue positioning device

Irreversible hydrocolloid impressions were made of the maxillary and mandibular arches and a bite registration was carried out with the lower jaw in a protruded position, in a silicone impression material of high viscosity (Virtual Refill®). Along with the bite registration, the forward position of the tongue was also recorded, using the same registration. The casts were mounted, with the help of the impression of the tongue position, the mandibular advancement and tongue positioning appliance were made using clear, heat processed, PMMA resin. The appliance placed intraorally enabled forward positioning of the mandible and mouth closure.

Mandibular advancement and tongue positioning appliance enabling forward positioning of the mandible

Due to the anterior positioning of the lower jaw, the tongue is repositioned to a more forward position, thereby preventing tongue fall back in the supine position.

Position of the tongue achieved with mandibular advancement and tongue positioning appliance

Other modalities described have the limitation of applicability in patients exhibiting exaggerated gag reflex, due to the contact of the appliance with the soft palate, uvula, velopharynx, and nasopharyngeal aperture.

Tongue repositioning maneuver with oral shields

The device is an improvisation of oral screens by attaching a funnel at front which is covered by a membrane. The membrane funnel oral shields allow the patient to form negative intraoral pressure during and after swallowing and thus continuously train the position of tongue on the hard palate with close tongue velum contact which is needed for posterior mouth closure. This provides effective training of nasal breathing, position of oral rest, and nocturnal assistance of mouth closure.

Titratable MAD

These are preferred for their integrated system through which mandibular protraction can be titrated or sequentially advanced in the sagittal plane until the acceptable level of subjective improvements occurs.[7] Titratable mandibular advancement works on adjustable mechanism that helps in slowly moving the mandible either forward or backward until successful results are achieved with the minimum possible protrusive position.

Oral Appliance Therapy

Among these devices, the MAD is the most commonly used and studied appliance.[23] MADs cover the upper and lower dentition and mechanism involves maintaining the mandible in a protruded position during sleep. By widening the upper airway and reducing collapse of upper airway (e.g. by improving upper airway muscle tone), these devices help in sustaining upper airway patency. Possible side effects that could hamper compliance include excessive salivation and poor retention on the short term and TMJ pain and myofascial discomfort on the long term, when MAD treatment is initiated.

Tongue retaining/reposition devices (TRDs) do not require support from dentition and can be used as an alternative in patients lacking sufficient dentition. TRDs have been reported to have a similar performance to that of MADs and use suction forces to hold the tongue in a forward position without mandibular repositioning.

Surgical Treatment

Several soft-tissue surgical procedures such as uvulopalatopharyngoplasty and radiofrequency ablation are available for OSA patients, although accompanied by varying success rates. In patients with severe OSA intolerant to CPAP or in whom oral devices have been found ineffective, maxillomandibular advancement surgery has favorable efficacy regarding surgical treatment options.

Conclusion

The upper airway collapsibility results due to complex relation between the anatomic and neuromuscular factors thus indicating that the etiology of OSA is multifactorial. It becomes our moral duty to diagnose and manage sleep apnea patients. When considering nonsurgical management of sleep apnea, oral appliances are considered as primary line of management for all the apnea patients. Also the custom mouth protectors are very simple, thus they help in protection of oral structures.

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