ROLE OF ORAL APPLIANCE IN CLINICAL MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA IN CHILDREN

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ABSTRACT

Obstructive sleep apnea (OSA) as repetitive episodes of upper airway obstruction that occur during sleep, usually associated with a reduction in blood oxygen saturation. OSA syndrome is thought to affect 1 – 3% of children. OSA can be treated with continuous positive air pressure (CPAP), oral appliance (OAs) and surgical intervention depending on the condition. In this article role of oral appliance, types and guidelines of using OAs in clinical management of OSA in children will be discussed

KEYWORDS: Obstructive sleep apnea, Oral appliance, Polysomanogram, Management

INTRODUCTION

Obstructive sleep apnea (OSA) is disturbance in normal sleep patterns; when combined with day time symptoms this condition is termed OSA syndrome [1].OSA is a sleep disorder in which repeated reactions or cessations in air flow occurs. This disorder may vary in its severity and is often associated with other physiological symptoms. The International Classification of Sleep Disorders [1] defines OSA as repetitive episodes of upper airway obstruction that occur during sleep, usually associated with a reduction in blood oxygen saturation.OSA syndrome is thought to affect 1 – 3% of children.[2,3]. Girls and boys show a prevalence of 2% for OSA; For snoring, it is between 3 and 12% [4].The soft tissue of the aryepiglottic folds and the epiglottis in young children are more susceptible to collapsing into the airway and less resistant to submucosal edema in comparison with adults. These characteristics are believed to predispose the child towards OSA. Common signs & symptoms associated with OSA in children can be divided into nocturnal and daytime signs and symptoms. Nocturnal signs and symptoms are drooling of saliva, xerostomia, sleep restlessness, choking or gasping and diaphoresis where as daytimes signs and symptoms include excessive sleepiness, xerostomia, morning headaches, non-restorative sleep, gastro-oesophageal reflexes, impaired concentration, depression and irritability. Patients with sleep apnea have a wide range of physical attributes. The population with OSA is a heterogeneous group, and patients with OSA may not have all of these physical features. The most common oro-facial characteristics encountered include retrognathic mandible, narrow palate, large neck circumference, long soft palate (which leads to dentists' being unable to visualize the entire length of the uvula when the patient's mouth is open wide), tonsillar hypertrophy, nasal septal deviation and relative macroglossia. The gold standard for diagnosing OSA involves having the patient complete polysomanography (an overnight sleep study) conducted in a laboratory. The polysomanogram records parameters including electrocephalogy (brain waves), electro-Occlulography (Eye movement), electrocardiography, electromyography (chin & leg movement), sleep positioning, respiratory activity and oxygen saturation[5] The sleep medicine team defines possible treatment options for children with OSA based on the severity of the sleep disorder, patient's preference, the patient's overall health, and the experience and preferences of the team members. Treatment options for OSA divided in to 3 categories depending on the condition and option of the clinician. They are

1) CPAP (Continous Positive Airway pressure)
2) ORAL APLIANCE (OAs)
3) SURGICAL INTERVENTION

The last decade has seen the emergence of oral appliances in the clinical management of snoring and obstructive sleep apnea (OSA). This has driven the need for simple and effective treatment options for obstructive sleep apnea in children. Different oral appliance design to reduce upper airway obstruction is not new. Pierre Robin[6] described such a concept in children with life-threatening upper airway obstruction related to micrognathia and glossoptosis, well before OSA was even recognized as a disorder. The use of oral appliances for the treatment of sleep related upper airway obstruction was first reported some 25 years ago [7,8] . A key milestone in the field was the systematic review conducted by the American Academy of Sleep Medicine (AASM)[9], highlighting the inadequacy of existing evidence at that time and the need for rigorous scientific evaluation.

Whilst it has taken a relatively long time for the evidence base to reach a level that supports their use in clinical practice, that time has now arrived, and it is important for clinicians involved in the management of snoring and OSA to have a sound working knowledge about this treatment modality. In general terms, this treatment approach relies on repositioning of the mandible and/or tongue and related soft tissues in such a way that the upper airway caliber is increased and the propensity to sleep-related airway narrowing and collapse is mitigated [10]. The potential advantages of such an approach, particularly relative to the current gold standard continuous positive airway pressure (CPAP), include its simplicity, portability, lack of noise and need for a power source, and potentially lower cost, all of which have a positive impact on patient acceptance.

TYPES OF ORAL APPLIANCES

Oral appliances used for OSA generally fall into one of two classes, viz. mandibular advancement splints (MAS) and tongue retaining devices (TRD). MAS induce protrusion of the mandible by anchoring a removable device to part of or the entire upper and lower dental arches, while TRD use a suction cavity to protrude the tongue out of the mouth. MAS are far more widely used in clinical practice and there is an extensive literature on their use, compared to TRD. There are many designs available, but they generally fall into either one-piece (monobloc) or two-piece (duobloc) configurations. Beyond this, they can differ substantially in size, type of material, degree of customization to the patient's dentition, coupling mechanism, amount of occlusal coverage, titratability of mandibular advancement, degree of mandibular mobility permitted (vertical and lateral), and allowance for oral respiration. The impact of these design differences on clinical outcomes is largely unknown at this stage, and this suggests the need for caution in extrapolating the results of studies using one type of appliance to all types of appliances.

Two-piece splints consist of an upper and a lower removable plate with some type of inter-maxillary coupling. There are several modes of coupling between the upper and the lower plates, such as elastic or plastic connectors, metal pin and tube connectors, hook connectors, acrylic extensions or magnets. There has been a steady shift toward the predominant use of two-piece appliances in clinical practice because of the advantages they often confer, including titratability over time and permission of movement (vertical and/or lateral). Although prefabricated appliances are commercially available, it is considered that the best retention, comfort and side-effect profile is achieved with custom-made oral appliances.

MECHANISMS OF ACTION

The prevailing view has been that the primary mechanism of action of MAS arises from the anterior movement of the tongue, and the consequent increase in the anteroposterior dimensions of the oropharynx. It now appears that this is an overly simplistic view, based on a growing number of studies that indicate rather more complex anatomical changes. Such studies have used a range of imaging modalities, including computerized tomography[11], magnetic resonanceimaging (MRI)[12], and nasopharyngoscopy[13]. Not surprisingly, airway volume increases with mandibular advancement. Of some surprise has been the consistent observation of an increase in cross-sectional area of the velopharynx, in both the lateral and anteroposterior dimensions and increases in the lateral dimension of the oropharynx. These changes are thought to be mediated through the intricate linkages that exist between the muscles of the tongue, soft palate, lateral pharyngeal walls, and the mandibular attachments. In particular, it has been proposed that the improvement in velopharyngeal dimensions is mediated through stretching of the palatoglossal and palatopharyngeal arches [14]. Notably, it appears that there is interindividual variability in the airway configurational changes that occur with mandibular advancement, and this is likely to have major

relevance to the variable clinical response associated with this treatment modality. There remains uncertainty about the extent to which oral appliance effects are mediated through neuromuscular pathways. Whilst there are some studies indicating that oral appliances stimulate genioglossus muscle activity [15,16] the clinical significance of this has not been borne out by "placebo" controlled studies using inactive oral appliances, which have shown little change in sleep-disordered breathing parameters [17,18.] This suggests that the primary mechanism of action is mechanical rather than neuromuscular. The mechanical effect results in greater airway stability, evidenced by reduced upper airway closing pressure during sleep [19]. In a study of anesthetized OSA patients, Kato et al. [20] found a dose dependent reduction in closing pressure of all pharyngeal segments.

The mechanism of action of TRD is likely to be a little different compared with mandibular advancement devices. The forward movement of the tongue out of the oral cavity tends to be greater than the tongue advancement achieved with a mandibular advancement device and this may produce more favourable anatomical changes in the retroglossal region. In addition, it is possible that they counteract the effect of gravity on the tongue in the supine position. A useful conceptual model for understanding the mechanism of action of an oral appliance is to consider the upper airway as a lumen, surrounded by soft tissue, and contained within a bony box [21].Hence one would predict that mandibular advancement would reduce tissue pressure by enlarging the box. This has been observed in an animal study, which found that mandibular advancement reduced tissue pressure and upper airway resistance [22]. In contrast, one would hypothesize that TRD reduce the amount of tissue in the box by pulling the tongue out of the mouth, thereby reducing tissue pressure.

CLINICAL OUTCOMES

Since the systematic review of 1995 [9], there has been a substantial increase in the quantity and quality of research evaluating oral appliances[10,23.] Whilst the early focus was on polysomnographic outcomes, there has been a necessary shift toward the evaluation of the impact of oral appliances on a range of important health outcomes, including daytime symptoms, neurocognitive function. The more recent studies have tended to employ rigorous randomized controlled trial methodologies and have advocated stringent, clinically relevant, definitions of treatment outcome. Comparisons with CPAP, other active and inactive oral devices, and oral tablet placebo have been published, assessing a range of important outcome measures. Despite this progress, there remain challenges in drawing definitive recommendations for clinical practice because of uncertainties about the generalizability of research findings to all types of oral appliances and patient subgroups. A contemporary systematic review, commissioned by the AASM, has formed the basis of revisions to the AASM practice parameters [24,25].

Polysomnography

The effect of oral appliances on polysomnographic outcomes has been extensively evaluated, and there is strong evidence of clinical benefit in controlling or significant reducing the number of obstructive breathing events and arousals, and improving arterial oxygen saturation, particularly in the mild-to-moderate OSA range. The overall success rate is dependent on the definition used, with almost 70% of patients achieving a greater than 50% reduction in the apnea–hypopnea index (AHI) [25], and up to 50% achieving an AHI <5/hour [17,18,26]. Given that the aim of treatment is to resolve OSA, it is important that the more stringent definition of treatment outcome be used. With regards to oxygen saturation parameters, studies have identified improvements in the minimum oxygen saturation, but rarely to normal levels. This is not surprising as, unlike CPAP, oral appliances do not inflate the lungs. With regards to sleep architecture and arousals, the data are less consistent, with only some studies reporting an increase in rapid eye movement sleep and reductions in the arousal index [17,18,26].

Less is known regarding the efficacy of TRD. Modest reductions in AHI [27], and improvements in minimum oxygen saturation and oxygen desaturation index [28]have been reported.

ORAL APPLIANCE PRACTICE

PARAMETERS[25] (An American Academy of Sleep Medicine Report)

The presence or absence of OSA must be determined before initiating treatment with oral appliances to identify those patients at risk due to complications of sleep apnea and to provide a baseline to establish the effectiveness of subsequent treatment. The severity of sleep related respiratory problems must be established in order to make an appropriate treatment decision.

Appliance Fitting

Oral appliances should be fitted by qualified dental personnel, who are trained and experienced in the overall care of oral health, the

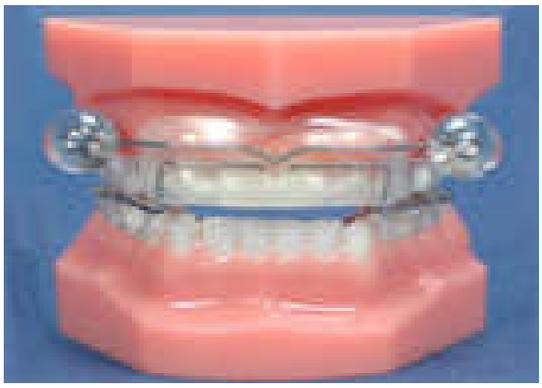

Fig.1 Mandibular advancement splint

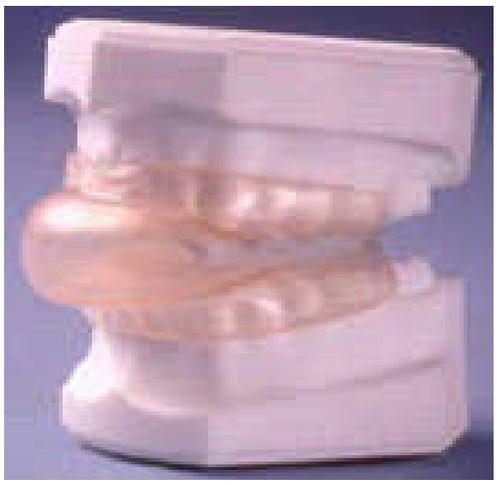

Fig.2 Tongue Retaining Device (TRD)

Fig.3 SomnoMed MAS Duobloc

temporomandibular joint, dental occlusion and associated oral structures.

Dental management of patients with OAs should be overseen by practitioners who have undertaken serious training in sleep medicine and/or sleep related breathing disorders with focused emphasis on the proper protocol for diagnosis, treatment and follow up. Although cephalometric evaluation is not always required for patients who will use an oral appliance, appropriately trained professionals should perform these examinations when they are deemed necessary

Treatment Objectives

For patients with primary snoring without features of OSA or upper-airway resistance syndrome, the treatment objective is to reduce the snoring to a subjectively acceptable level. For patients with OSA, the desired outcome of treatment includes the resolution of the clinical signs and symptoms of OSA and the normalization of the apnea-hypopnea index and oxyhemoglobin saturation. Oral appliances are appropriate for use in patients with primary snoring who do not respond to or are not appropriate candidates for treatment with behavioral measures such as weight loss or sleep-position change. Although not as efficacious as CPAP, oral appliances are indicated for use in patients with mild to moderate OSA who prefer OAs to CPAP, or who do not respond to CPAP, are not appropriate candidates for CPAP, or who fail treatment attempts with CPAP or treatment with behavioral measures such as weight loss or sleep position change. Patients with severe OSA should have an initial trial of nasal CPAP because greater effectiveness has been shown with this intervention than with the use of oral appliances. Upper airway surgery (including tonsillectomy and adenoidectomy, craniofacial operations and tracheostomy) may also supersede use of oral appliances in patients for whom these operations are predicted to be highly effective in treating sleep apnea.

Follow-up

Follow-up sleep testing is not indicated for patients with primary snoring. To ensure satisfactory therapeutic benefit from OAs, patients with OSA should undergo polysomnography or an attended cardiorespiratory sleep study with the oral appliance

in place after final adjustments of fit have been performed. Patients with OSA who are treated with oral appliances should return for follow-up office visits with the dental specialist. Once optimal fit is obtained and efficacy shown, dental specialist follow-up at every 6 months is recommended for the first year, and at least annually thereafter. The purpose of follow up is to monitor patient adherence, evaluate device deterioration or maladjustment, evaluate the health of the oral structures and integrity of the occlusion, and assess the patient for signs and symptoms of worsening OSA. Intolerance and improper use of the device are potential problems for patients using oral appliances, which require patient effort to use properly. Oral appliances may aggravate temporomandibular joint disease and may cause dental misalignment and discomfort that are unique to each device. In addition, oral appliances can be rendered ineffective by patient alteration of the device. Patients with OSA who are treated with oral appliances should return for periodic follow-up office visits with the referring clinician. The purpose of follow up is to assess the patient for signs and symptoms of worsening OSA. Close communication with the dental specialist is most conducive to good patient care. An objective reevaluation of respiration during sleep is indicated if signs or symptoms of OSA worsen or reoccur

CONCLUSION

Oral appliance has got vital role in treating OSA in children especially in mild to moderate cases. Dental clinicians should take help from sleep experts to check the compatibility of the oral appliance with polysomonography. Further research to define more clearly patient characteristics for OAs acceptance, success, and adherence is needed .

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