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CASE STUDY

TREATMENT OF OBSTRUCTIVE SLEEP APNEA WITH MODIFIED MANDIBULAR ADVANCEMENT APPLIANCE: A CLINICAL REPORT

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ABSTRACT

Obstructive sleep apnea (OSA) is the most common sleep-related breathing disorder with periodic reduction or cessation of airflow during sleep. It is associated with loud snoring, disrupted sleep and observed apneas with prevalence up to 54% in elderly people. Treatment of OSA varies from simple measures such as dental appliances and nasal continuous positive airway pressure (CPAP) to surgical procedures like Uvulopalatopharyngoplasty and tracheostomy. Dental appliances are a viable nonsurgical treatment alternative in patients with OSA, of which mandibular advancement appliances are most common. A Class II patient with retruded mandible contributes to the worsening of OSA is considered an indication to oral appliance therapy. This clinical report describes the treatment of a 32-year old Class II OSA patient for whom a modified mandibular advancement appliance was designed. The patient reported an improvement in AHI index and he was satisfied with the modified appliance.

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INTRODUCTION

Obstructive sleep apnea (OSA) is a common chronic disorder of sleep and breathing that causes disability from pathologic sleepiness and respiratory and cardiovascular complications but its pathogenesis is not fully understood (Guilleminault *et al.,* 1976, Young *et al*., 1993). Several cephalometric differences between OSA patients and control samples have been reported. These include mandibular deficiency, bimaxillary retrusion, short cranialbase, reduced cranial base angle, mandibular length, increased lower anterior facial height, Maxillomandibular plane angle, craniocervical angulation, inferiorly positionedhyoid, and enlarged soft palate (Hou *et al.,* 2006). With a prevalence of 2–4% in the United States it is a major medical problem affecting up to 4% of middle-aged adults (Pe'pin *et al.,* 1995). The prevalence rises with age, to an estimated 28–67% for elderly men and 20–54% for elderly women (Meurice *et al.,* 1994). The most common complaints are loud snoring and disrupted sleep. Snoring is a common problem, affecting persons of all ages, but particularly middle-aged and elderly men and women (Lugaresi *et al.,* 1980, Bloom *et al.,* 1988, Schmidt-Nowara *et al.,* 1990). The pathophysiology of OSA includes factors related to upper airway anatomy, upper airway resistance and upper airway muscle function during sleep (Hudgel *et al*., 1992, Haponki *et al.,* 1983). The various options available in the treatment of OSA are nasal continuous or bi-level positive airway pressure (nCPAP/biPAP), oral appliances and surgical procedures (Findley *et al*., 2000). NCPAP since its introduction in the 1980s is considered as the primary treatment for moderate to severe OSA. However, side effects associated with nCPAP use are frequently reported (Pe'pin *et al.,* 1995, Meurice *et al.,* 1994). The use of oral appliances in treating OSA was first described in 1982 (Cartwright *et al.,* 1982). The first findings, which document the therapeutic effect of mandibular advancement devices were presented in 1984. Of the many oral appliances designed for use in the treatment of OSA, mandibular advancement devices have been the most intensely researched.

Several authors stated in their studies that oral appliances are a good alternative for the treatment of snoring and OSAS due to their low cost, relative comfort, and ease of use, which can therefore lead to greater patient compliance. Some issues, however, warrant further substantiation if the therapy is to become an effective and safe alternative for treating these respiratory ailments. Among these issues are a correct indication compatible with OSAS severity, the diversity of available appliances, definition of the basic features these appliances

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should be able to provide, and differences in individual responses to therapy. The purpose of this study was to evaluate the improvements obtained with a mandibular advancement device in accordance with the following indices: apnea hypopnea index (AHI) per hour of sleep, apnea index(AI) per hour of sleep, mean oxyhemoglobin saturation, sleep efficiency, and percentage of REM sleep (Teixeira *et al.*, 2013).

Clinical report

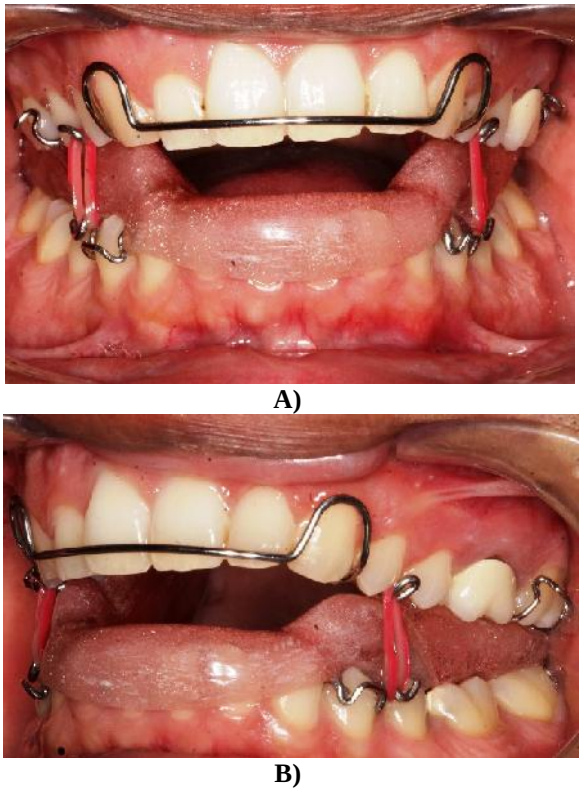
A 32- year old patient was referred to the Department of Orthodontics and Dentofacial Orthopaedics by Department of Oral Medicine, Diagnosis & Radiology of Sinhgad Dental College and Hospital with the history of snoring and disturbed sleep.Patient complained of severe snoring, wake gasping and choking, daytime drowsiness, headache and insomnia. Medical history of the patient did not reveal any pre-existing diseases. History also revealed that patient did not have habit of sedatives, alcohol or smoking. The patient was diagnosed with mild OSA, having an apnea–hypopnea index (AHI) of 11.0/h.
An extra oral evaluation of the patient was made which shows retruded mandibleand convex profile, followed by an intra-oral examination. The patient dental history revealed Class II molar and canine relationship on both side and deep bite.

Procedure

The patient was screened by neurologists certified in sleep medicine in their private office based on medical history and evidence of obstructive sleep apnea syndrome by means of overnight polysomnography. Based on this this diagnosis, they believed a patient could be treated with oral appliance, so was referred for evaluation to the department of orthodontics and dentofacial orthopaedics at Sinhgad dental college and hospital. Before sending to the department of orthodontics, the patient was oriented about the different treatment modalities for OSAS.

Appliance

A twin block (TB) experimental mandibular advancement device was modified for use in this situation. It consisted of two parts, one for the upper arch and one for the lower. It was fabricated from self-curing acrylic resin with occlusal coverage on all teeth so as to reducechanges in tooth positioning that might arise from its use. Each piece had, on its occlusal surface, bilateral slopes with approximately 45° inclinations which, when joined, caused the mandible to advance by 75% of each patient's maximum mandibular advancement capacity. These slopes produced an interincisal opening of 8 mm on average. To enhance retention of these devices, four Adams clasps were placed bilaterally on the upper arch (two on the canines and two on the first molars). These clasps could be displaced in the absence of said teeth. Two Adams clasps were placed bilaterally on the first premolars of the lower arch with extensions toward the canines with welded hooks. These clasps, like the ones on the upper arch, could be displaced if these teeth were missing. To ensure that the mandible would remain in an advanced position during sleep, elastics were placed connecting the Adams clasps on the upper canines with the extension hook on the lower clasp. The elastic was medium force, size 3/16 inch (Figure 1A, B).



A)

B)

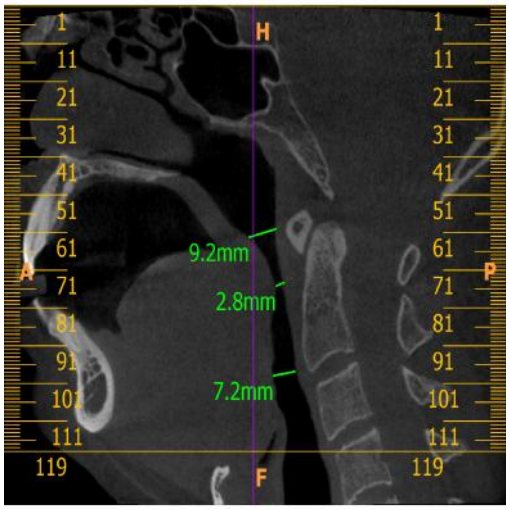
Figure 1. Twin block appliance in place. (A) Frontal view and (B) Side view of applaince in place

The appliance was evaluated in the patient's mouth for any discomfort (Fig. 1) and was further evaluated using polysomnography (PSG) and cephalometric radiographs to check for any increase in the upper airway dimensions (Fig. 2). Polysomnography is a comprehensive recording of the bio physiological changes that occur during sleep. The PSG monitors many body functions including brain (EEG), eye movements (EOG), muscle activity or skeletal muscle activation (EMG) and heart rhythm (ECG), oronasal airflow by thermistors, oxygen saturation by pulse oximetry and abdominal and respiratory effort by strain gauge during sleep. The patient was subjected to all night video electroencephalogram (EEG) and polysomnography (PSG) on 21 channel polygraph (ResMed) at 10 mm/s paper speed, as per the standard protocol. The obtained data was analysed and scored and was sent to a qualified neurologist, experienced in sleep disorders for interpretation. Interpretation was done in conjunction with the medical history and sleep apnea was diagnosed as per the American sleep disorders association (ASDA) criteria. The patient was advised to wear / use the appliance only at night time during sleep.

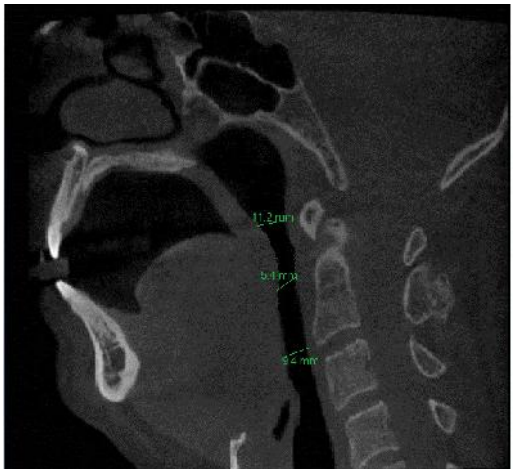
RESULTS

The patient on evaluation after 1, 4, 6 and 24 weeks reported a favourable sleeping pattern without any discomfort. Patient reported that snoring, wake gasping and choking were reduceddrastically and also reported improved sleep at night

without apneas and his daytime head ache and drowsiness had diminished considerably, which was also confirmed by the wife of the patient. Upright cephalometry of the patient with the modified appliance in place showed an increase in the upper airway dimensions. Furthermore, the patient was advised toundergo a PSG test with the appliance in position to have an objective measurement of respiration during sleep. The results of the test confirmed that the patient's AHI had decreased to 5.0.



A)



B)

Figure 2. (A) Axial view of CBCT before appliance therapy (B) Axial view after appliance therapy

DISCUSSION

Recent advances in dentistry coupled with ongoing research in the appliance therapy has led to fundamental modification in the design of mandibular advancement devices. The results of this study demonstrated clinically that the twin block mandibular advancement device (TB) can be an alternative treatment for OSAS, corroborating other studies which found that oral appliances have indeed emerged as an alternative treatment for this syndrome (Teixeira *et al.*, 2013). Mandibular advancement devices are more often indicated than CPAP given the former's greater comfort, which theoretically would tend to increase patient compliance and satisfaction leading to greater adherence to treatment (Ellis S *et al.*, 2003), in addition to lower treatment costs. All these factors hinder the use of CPAP, despite its proven greater effectiveness. The use of a modified TB was based on issues such as cost, ease of fabrication, and greater mandibular motion. The cost, should be taken into account because nowadays, OSAS is considered a public health problem before, it is prescribed and applied to a large portion of the population, it should become affordable. For this reason, it is important that TB be easy to manufacture so it can be easily produced by a large number of laboratories, requiring no training or very specific materials, which could lead to increased costs and access difficulties. Mandibular freedom of motion is yet another factor that makes TB rather appropriate for use in these situations. Mandibular freedom fosters patient comfort, both because patients do not feel that their mouth is stuck and because it offers a certain degree of joint comfort, since protrusion force in itself tends to cause discomfort. Use time evaluated in the report was approximately 6.5 months since the goal was to evaluate long-term results and not just immediate results. This type of evaluation was considered more appropriate because short-term evaluationmight produce short-lived results, whereas this therapy should last a whole life time (American Academy of Sleep Medicine *et al.*, 2014, Sleep Health Foundation *et al.*, 2011) Cone-Beam Computed Tomography (CBCT) has contributed to orthodontics with information concerning the upper airway space. By producing three-dimensional images CBCT allows professionals to accurately determine the most constricted area, where greater resistance to air passage occurs. Subject with an upper airway lateral dimension of the cross-sectional airway less than 17 mm was 3.9 times more likely to have OSA (Farman *et al*., 2009) The fact that a subject with a narrow lateral dimension was 3.9 times more likely to have OSA makes sense as prior studies have found a narrowing of the airway due to thickening of the lateral pharyngeal walls during sleep in normal subjects, as well as a significant increased risk of sleep apnea the larger the lateral pharyngeal walls. Lateral narrowing of the airway is also associated with lateral hypertrophy of the lateral tonsils (Farman *et al*., 2009)

Two main factors are likely to yield different assessments, depending on how long the appliance is used: Airway enlargement caused by muscle stretching and a reduction in upper airway edema. Assuming that TB could have reduced the airway edema, a minimum time period would be required to allow the original conditions to be restored. Average TB use time for assessment was approximately 6 months. Individual improvement reports are not acceptable since subjective improvements not always match objective improvements, and systemic changes produced by OSA may continue to progress if the condition is not controlled, even if the patient is feeling better (Lowe *et al*., 1994, Johal *et al*., 1999)

Conclusion

Disorders and disturbances of sleep are widespread and can have significant consequences for affected individuals as well as economic and other consequences for the society. Sleep medicine is rapidly evolving and challenging field which is making great strides with the presence of new technology.

Dental sleep medicine is also growing rapidly in popularity because of the major new discoveries and the growing evidence based studies being used in clinical research. Oral appliances are often regarded by patients as a more acceptable treatment option for OSA in lieu of the other treatment options available. This has the potential to translate into better treatment adherence and equivalent health benefits. The advantages of the appliance in study are that it is simple to fabricate, comfortable and economical to the patient. It is also a simpler alternative to the existing oral appliances used in the treatment of OSA. More follow-up data are needed to define the rate of compliance and the risk of complications. Future research should focus on determining the influence of the design of oral appliances on clinical outcome and the characterization of factors predisposing to long-term adverse effects of oral appliance treatment.

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