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CASE REPORT

Efficacy of mandibular advancement devices in two patients with moderate obstructive sleep apnea: Case reports

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ABSTRACT

Oral appliances are an alternative to continuous positive airway pressure (CPAP) for the treatment of obstructive sleep apnea (OSA). Mandibular advancement device (MAD) is a popular treatment alternative particularly for mild to moderate OSA. Polysomnographic (PSG) evaluation were performed on two patients before and about one year after continuous use of the MADs. The results were compared. In the first case, the apnea-hypopnea index (AHI) before treatment was 22.0 and decreased, to 4.3, after one year of treatment. After one year, the AHI differ significantly from the pretreatment value. In the second case, before treatment, the AHI was 21.4 and decreased to 10.1 after one year of treatment. The one year follow-up showed that occlusion was preserved, masticatory muscles and temporomandibular joint (TMJ) were protected. The MADs reduced apneas and improved sleep quality in patients with OSA.

INTRODUCTION

Obstructive sleep apnea (OSA) is a sleep disorder characterized by obstruction of the upper airway, which results in cessation of air flow in the presence of continuous respiratory effort. Patients with OSA show hypersomnolence (excessive daytime sleepiness), heavy snoring during sleep periods, and disturbed/restless sleep. Studies have shown that patients with OSA can develop hypercapnia, hypoxia, hypertension, polycythemia, and cardiac dysrhythmias. Treatment modalities for OSA include surgery, medications, correction of sleep posture, continuous positive air pressure (CPAP), and oral devices.[1,2]

Oral devices are prescribed for the treatment of snoring and mild-to-moderate OSA. Oral devices are of two basic configurations, the tongue-retaining device

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(TRD) and the mandibular advancement device (MAD). Oral devices generally work by directly or indirectly preventing the tongue from approaching the posterior wall of the pharynx and hence compromising the airway space.[3] TRDs work through the use of a hollow bulb and sufficient vacuum to hold the tongue forward.[4] MADs work indirectly by holding the mandible and hence the tongue forward. These devices also aid in preventing the hyoid bone from dropping posteriorly and its overlying tissues from impinging on the upper airway. Generally, oral devices increase the size of the upper airway by advancing either the mandible or the tongue. MADs are the most widely used type of oral device. Patient compliance with oral devices is better than with continuous positive airway pressure (CPAP). Oral devices are extremely successful in treating patients with only snoring problems.[5-7]

In this clinical report, the fabrication of MADs for two patients with OSA and the outcome of treatment were presented. The therapeutic effects of the devices were analyzed.

CASE REPORTS

A 52-year-old Turkish female patient and a 26-year-old Turkish male patient were referred from the Council of the Sleep Related Breathing Disorders of Ataturk Chest Diseases & Chest Surgery Education and Research Hospital with a history and diagnosis of intrusive snoring and moderate OSAS. All participants underwent a full-night polysomnogram (PSG), using the Compumedics Voyager Digital Imaging 44-channel E-series system. Sleep stages as well as respiratory parameters were scored according to the standard criteria of American Academy of Sleep Medicine.

The patient was examined to the Department of Prosthodontics, Faculty of Dentistry, Hacettepe University. 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 patients had complaints of daytime sleepiness. Daytime sleepiness noticed as a major compliant of the patients.

The patients had moderate OSA, which caused disturbed sleep in the REM period. The AHIs for cases 1 and 2 were 22.0 and 21.4 per hour of sleep, respectively. In both patients, panoramic radiograph for teeth were taken and examinations of teeth and restorations was made. There was not caries and need of restoration. Periodontal tissues, TMJ and occlusal examination, intraoral habit assessment were made. Facial and skull characteristics was evaluated. There was not structural abnormalities in the face and skull as micrognathia or retrognathia. There was enlarged tongue. The soft palate was stiffer, larger than normal. There was not abnormalities or weakness in the masticator muscles. There were not obese and their neck measurements were normal limitations. There was no nasal breathing problems.

The patients were fully dentate and had class 1 occlusion. TMJ condition of the patients was normal. There was not any limitation and any sound.

Maxillary and mandibular impressions were obtained with irreversible hidrocolloid impression material (Kromopan; Lascod, Firenze, Italy), casts were obtained with the use of a dental stone type III (Moldano; Bayer Co., Leverkusen, Germany). The interocclusal records were obtained with the patients protruded 75% of their maximum protrusive movement (Fig. 1A). The method described by Taylor[5] was used. Firstly, a tongue blade is placed between the maxillary and mandibular incisors with the patients in the normal occlusal position. A small mark was made on both the top and bottom of the tongue blade

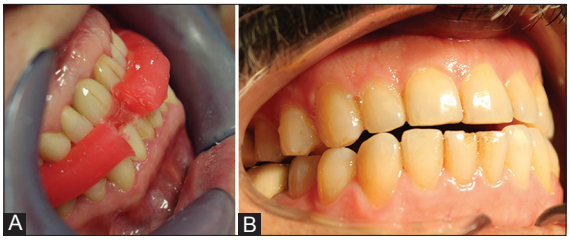

Figure 1. A: Mandibular position obtained using wax recording, first case. B: Second patient's protruding 75% of her maximum protrusive movement

in the midline and against the maxillary and mandibular incisors. The mark on the maxillary side of the tongue blade was in its initial position, the patients were asked to thrust the mandible as far forward as possible in a protrusive movement with minimal lateral deviation. A second mark was made indicating the patient's maximum protrusive position. Seventyfive percent of the difference between the two marks was determined by measuring the distance between the two marks and multiplying the distance by 0.75. This position, 75% of the distance between the maximum intercuspation and maximum protrusive position, was indicated on the bottom of the tongue blade by measuring anteriorly from the most posterior initial mark toward the second mark. A third mark at this position was made. This third mark was obviously be approximately two thirds the distance from the first mark to the second. When making the interocclusal record, the tongue blade was positioned so that the mark on the maxillary arch was maintained in its initial position, and the patients were instructed to move the mandible forward until the incisors touch the mark indicating 75% position. An interocclusal record was made at this point. Secondly, the tongue blade was also used to determine the maximum vertical opening of the mandible. The patients were asked to open to maximum height, and one end of the tongue blade was placed on the mandibular central incisors in the midline. An edge of the tongue blade was placed against the midline of the maxillary central incisors and the level of the incisal edge of the incisors was indicated by a mark. The distance from the end of the tongue blade to this mark indicates the maximum vertical opening in the incisor area. Maximum vertical opening wasn't used. About 30 to 35 mm of vertical opening was determined.

Casts were mounted in a simple hinge articulator (Evodent, Turkey) with the maxillomandibular relation occlusal record (Fig. 1B). Using clear acrylic resin material (Meliodent, Heraeus Kulzer, Germany), splints were made on both casts. Subsequently, vent holes were placed in the middle of the block. The devices were removed and the contours were completed extraorally, finished, and polished (Fig. 2A, B).

Post-insertion instructions on use and care were provided at insertion of the MAD. Follow-up evaluation at 2 weeks, 1 month, and then at 6-month intervals is vital in evaluating retention, gingival conditions, tooth mobility and sensitivity, and tooth movement. At the first monthly review, the patients reported that their sleep at night had improved and their daytime somnolence had diminished. The patients underwent polysomnographic follow-up recordings after one year and the AHI for cases 1 and 2 were 3.0 and 10.1 per hour of sleep, respectively (Table 1).

DISCUSSION

The aim of present study was the evaluate the efficiency of custom made MADs on the PSG values of two patients with moderate obstructive sleep apnea. CPAP has been shown to be more effective than oral devices in improving sleepiness, health status, and remains the primary treatment for OSA. Current guidelines recommend oral devices for selected patients with

Table 1. The polysomnographic results of case 1 and 2

	Case 1		Case 2	
	Before treatment	During treatment	Before treatment	During treatment
Total recording time	465 min.	449.0 min.	436.9 min.	473.4 min.
Total sleep time	270.5 min.	279.5 min.	398 min.	443.5 min.
Sleep latency	14.5 min.	21.5 min.	0.5 min.	23.5 min.
REM latency	115.5 min.	75.0 min.	85.5 min.	131.0 min.
Sleep efficiency	58.2%	62.2%	91.1%	93.8%
Total REM sleep time	21 min. (7.8%)	24 min. (8.6%)	69%	68.5 min. 15.4%
Total stage N1	9.2%	7.5%	1.6%	0.9%
Total stage N2	62.1%	66.9%	74.6%	57.7%
Total stage N3	20.9%	17.0%	6.4%	25.9%
AHI REM sleep stage	65.7	12.5	0.0	0.9
AHI NREM sleep stage	18.3	3.5	47.8	11.8
AHI total	22.0	4.3	21.4	10.1

mild OSA and normal daytime alertness. Furthermore, oral devices are the best alternative treatment for patients with OSA who are unwilling or unable to comply with CPAP therapy. Oral device therapy may also be indicated as an adjuvant to CPAP when the patient is away from home or without electrical power.[8,9]

The effects of devices in OSA have been reported to be variable.[10-14] Previous studies have indicated that the success rate with the MAD is higher in those with moderate sleep apnea than in those with severe sleep apnea.[11-16] O'Sullivan *et al*.[14] reported that MAD is more effective in patients with AHIs of between 20 and 60 than in those with an obstructive apnea-hypopnea index of > 60.

The two cases in this report had moderate obstructive sleep apnea. There were few studies that analyzed the success of the treatment by the severity of the OSA.[17] These studies found lower success rates in more severe OSA (as defined by AHI). The success rates in mild to moderate OSA averaged 57 to 81%. Success rates ranged between 14 and 61% among those subjects who were classified as severe (AHI defined as >30 in some studies and >40 in others)

The MADs were well-tolerated by the patients. When tolerated, compliance and efficiency are preserved over the long term without oral or jaw dysfunction. A follow-up sleep recording during treatment is necessary because of the risk of silent

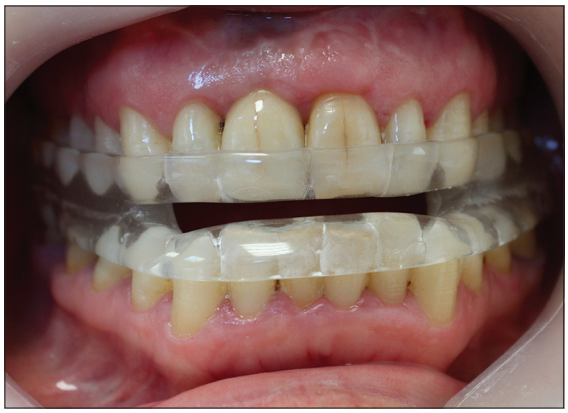

Figure 2A. Intraoral view of completed device for the first case.

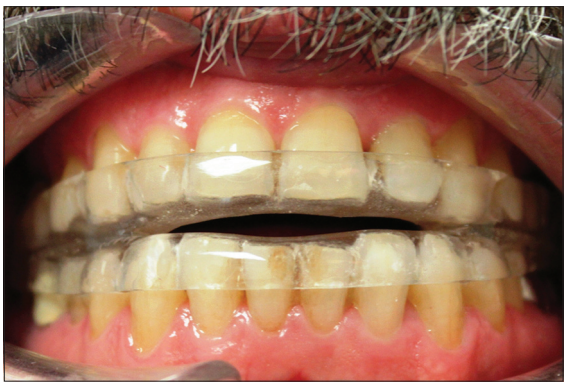

Figure 2B. Intraoral view of completed device for the second case

obstructive apneas without subjective snoring with the device.[18]

Construction principles for the device must include consideration of protrusion, upgrade to the occlusal vertical dimension, anterior opening, occlusal coverage, and retention.[19] Without this, it may actually worsen symptoms. 30 to 40 mm of vertical opening distance was very important for those patients who receive a one-piece oral device to allow insertion of the device.

In the present study, a satisfactory treatment result was found at mandibular advancements ranging from 75% to maximum protrusion. Clark *et al*.[20] suggested that > 75% of maximum protrusion is needed for a satisfactory effect. However, unnecessarily large mandibular advancements should be avoided, because long-term negative side effects on occlusion and the temporomandibular joints are known to occur.[20-22]

After a short-term PSG follow-up, it was determined that the number and the duration of apneic events decreased, and the guality of the sleep was improved in both patients when the devices were worn during sleep. According to the results of polysomnography, there was significantly improved sleep and fewer and shorter apneic events on nights when the devices were worn. There was no central or mixed apneic episode. The arousal index decreased (in the first patient from 3.0 to 0.4, in the second patient from 3.5 to 0.46) and the sleep stage patterns improved in the patients.

The device reduced the median AHI from 22.0 to 4.3 in the first patient, and from 21.4 to 10.1 in the second patient, with moderate sleep apnea. The sleep time spent in the supine position increased in all patients. Snoring was satisfactorily reduced during treatment with the device (Table 1). The present results indicate that sleep stages and arousal frequency changed towards a more normal pattern during treatment with the MADs. The patients reported daytime sleepiness before treatment and a reduction in daytime sleepiness with the device.

Nasally applied CPAP is considered to be the long-term treatment of choice and is regarded as the gold standard.[7-9] However, MADs can also be used in suitable cases; the AHI decreases significantly after insertion of the device. The polysomnographic analyses revealed that the devices were effective in these patients.

In conclusion, treatment with MAD reduces apnea and improves sleep quality in patients with mild and moderate sleep apnea. A satisfactory treatment result is likely to occur in such patients.

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