Management of Moderate Obstructive Sleep Apnea with Mandibular Advancement Device

Reena R Kumar, Mayank Gahlot, Anil Miglani, Nameeta Kaur

ABSTRACT

Introduction: Obstructive sleep apnea (OSA) is part of the spectrum of sleep disordered breathing with severe social and life-threatening consequences.

Case report: Female patient was diagnosed in orthodontic clinic with moderate OSA and confirmed by overnight polysomnography with apnea hypopnea index (AHI) of 77 per hour. A cost-effective oral appliance—mandibular advancement device (MAD) was custom fabricated as she was noncompliant to continuous positive airway pressure (CPAP).

Results: AHI reduced from 77 to 27 with cessation of snoring and daytime sleepiness with improved quality of life with MAD.

Conclusion: This case report highlights the role of oral appliances in the management of mild to moderate noncompliant OSA cases. CPAP continues to be the gold standard for conservative management of OSA though patient compliance still remains uncertain.

Keywords: Obstructive sleep apnea, Continuous positive airway pressure, Oral appliance, Mandibular advancement devices.

INTRODUCTION

Obstructive sleep apnea (OSA) is a sleep-related breathing disorder (SRBD) notified in the classification of the American Academy of sleep medicine and characterized by repetitive episodes of upper airway obstruction, resulting in pauses in breathing during sleep in association with reduction in blood oxygen saturation. The respiratory consequences of obstructive sleep apnea syndrome (OSAS) are related to the extent of hypoxemia and hypercapnia that develop due to the disordered breathing. The cardiovascular consequences of OSAS may include systemic hypertension, cardiac arrhythmias, myocardial infarction and cerebral vascular accidents, which have a high mortality rate. The gold standard for diagnosis of OSA is based on assessment of respiratory parameters by overnight polysomnography (PSG). The number of apnea and hypoxia events experienced during sleep are assessed to calculate the apnea/hypopnea index (AHI) of the patient and used to grade the OSA into mild, moderate and severe. An AHI of <5 is considered normal.

Conservative management of OSAS is the preferred option of the medical fraternity. Reduction of body mass index (BMI) and lifestyle changes help to some extent. Continuous positive airway pressure (CPAP) developed by Sullivan is considered the gold standard of conservative management. This device ensures a flow of pressurized air into the airway during sleep. Literature reports indicate patient compliance to CPAP to be low as 46%. The reasons for low compliance are physical discomfort, drying of nasal and oral mucosa, noise and social implications. Drugs like Protriptyline and Medroxyprogesterone have reasonable symptomatic improvement of OSAS but have anticholinergic side effects which limit their use. Surgical management of OSAS is replete with controversy and patients are hesitant to undergo the surgical procedure. Hence, it is obvious that there is a need to find an alternative treatment modality.

Orthodontists and dental surgeons can play a vital role in sleep medicine both in the diagnosis and management of patients with OSA and especially for those who are noncompliant to CPAP therapy. In several studies on selected obstructive sleep apnea patients, oral appliances have shown improvement of symptoms and of objectively measured breathing parameters.

This is a case report of a female patient who was diagnosed with moderate OSA in an orthodontic clinic. She was treated with a simple, low cost, custom-made mandibular repositioning oral appliance for nocturnal wear. Patient responded well with relief of symptoms during the 1 year follow-up.
A 27 years female dental student was found to exhibit sleepiness in the working hours regularly and on questioning it was elicited that she had increased day time sleepiness with a tendency to doze. She had restless nights with snoring and also complained of ankle edema. The patient felt tired and had decreased work efficiency and morning headaches routinely.

Clinical Features

Patient weighed 180 lbs and stood 162 cm tall. She had a thick soft tissue covering over the neck with a neck circumference of 17 inches and a BMI of 32.1 (Figs 1A and B).

Examination

Patient had a brachycephalic head form and a mildly convex facial profile, deep mentolabial sulcus and Angle’s Class II malocclusion with an overjet of 3 mm and an overbite of 2 mm. She did not have any other systemic disorder. History revealed that 13 years ago, she underwent fixed orthodontic treatment with extraction of 14 and 24. She seemed to have a visibly small sized mandible. Intraoral dental examination did not reveal any specific finding.

The patient revealed a Class II skeletal pattern with retrognathic mandible with SNB of 67°, ANB of 5° and effective mandibular length of 49.1 mm. The cephalmetric skeletal parameters are in Table 1.

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Airway Assessment

1. The patient was also given an Epworth Sleepiness Scale (ESS) questionnaire consisting of eight simple questions to self assess the severity of sleepiness and thus estimate the severity of the problem. She scored 14 indicating a moderate case (Fig. 2).

2. The Mallampati Index was ascertained and she scored Class III, indicating that only the base of the uvula and soft palate was visible (Fig. 3). There was inadequate visibility of uvula and no visibility of anterior and posterior pillars of the pharynx and the fauces. The patient had inadequate airway patency.

3. The cephalometric airway assessment was done to measure the nasopharyngeal airway space (NAS): 12 mm, the superior pharyngeal airway space/velopharyngeal airway space (SAS/VAS): 6 mm, the posterior airway/oropharyngeal airway (PAS/OP): 9 mm and hypopharyngeal airway space (HAS): 12 mm (Fig. 4 and Table 2).

4. Polysomnography: The patient was advised to undergo an overnight PSG to conclusively diagnose OSA. Overnight respiratory analysis of thoracic/abdominal flow, respiratory effort, EEG, EMG, ECG and oximetry was conducted. Ocular movements to stage the sleep was also done as part of the PSG (Figs 5A and B).

344 minutes of sleep recording of the parameters revealed 77 obstructive apneas and 68 hypopneas and diagnosis of moderate OSA was established.

Table 1: Pretreatment cephalometric values

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Fig. 1A: Frontal extraoral photograph

Fig. 1B: Profile extraoral photograph

Fig. 2: Epworth sleepiness scale
CPAP Titration

A CPAP titration was done at the same center (Fig. 6), a day after the initial diagnosis was made, to confirm OSA. The CPAP titration was done to ascertain if airway patency and oxygen saturation normalized when the CPAP with air at continuous positive pressure was given. The results indicated that the AHI normalized to 1 and snoring ceased and this confirmed the diagnosis of moderate OSA.

Treatment Alternatives and Management

The patient was advised CPAP therapy by the pulmonologist. She refused as she was averse to the idea of sleeping with a mask. Hence the treatment objectives were defined as:

• An alternative to CPAP therapy.
• To reposition the mandible forward to increase the patency of airway.
• To decrease the incidence of apneic and hypopnic events.
• Provide a better quality of life with improved sleep pattern.

As the patient was noncompliant to CPAP therapy, a mandibular advancement device (MAD) was thought of as an alternative. A simple cost-effective MAD simulating a twin block was designed and fabricated in the Department of Orthodontics and Dentofacial Orthopedics. Functionally

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Fig. 5A: Diagnostic overnight PSG

Fig. 5B: Diagnostic PSG report

Polysomnography Report
Patient Name: [Redacted] Date of Birth: 22/12/1982
Date of Recording: 30/11/2009
Study Performed: Nocturnal polysomnography

Montage: This is a conventional polysomnography study performed during the patient; habitual sleep period in accordance with standards established by the American Academy of sleep medicine. Parameters include bilateral electro oculographic tracings; Electroencephalographic tracing (modified 10:20 electrode configuration, featuring bilateral central and occipital leads); surface electromyography of submental musculature and bilateral anterior tibialis muscles; thoracic and abdominal piezocrystal respiratory belt recording; electrocardiography; arterial oxygen hemoglobin saturation via finger pulse oximetry; and snoring intensity via decibel meter recording. ‘Hypopnea’ is defined by this center as a 30 to 70% decrease in airflow or respiratory effort lasting 10 seconds or longer in association with a 3% or greater oxygen de saturation, electrography evidence of arousal, or both.

Summary: Total recording time was 386 minutes, with a total sleep time of 334 minutes and a sleep efficiency of 86.5%. There was a total of 306 minutes. REM sleep. There was 86.5% of stage 1, 86.5% of stage 2, 47.2% of stage 3.

Respiratory analysis demonstrated 76 obstructive apneas and 68 hypopneas, with an apnea hypopnea index (AHI) of 18.2 REM and 27.0 NREM.
The lowest saturation was 84% mean saturation of 94%.

Observation: Moderate OSA
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Appliance Construction

Hydrocolloid impressions of the upper and lower dental arches were made and casts were poured. Patient was trained to achieve and reproduce the optimum mandibular advanced position without discomfort in the temporomandibular joint. The sagittal, transverse and vertical maxillomandibular relationship was established by a wax-bite registration with a 3 mm sagittal advancement and 3 mm vertical opening. The wax bite was transferred to an articulator for laboratory in-house fabrication of the MAD (Fig. 7).

The removable acrylic MAD designed had the following components (see Fig. 7):
1. An upper and lower member with claspers on first molars and central incisors of upper member.
2. The lower member had claspers on first molars and additional incisal capping.
3. Inclined planes of 70° were placed between the upper and lower members at the premolar region to facilitate the advancement of mandible.

Treatment Results

The patient adapted quickly to the new appliance and wore the appliance at night during sleep. An overnight PSG was repeated with the appliance in place after 6 weeks. A marked decrease in the AHI was observed with the apneic events.
Table 3: Comparison airway parameters pre- and post-MAD

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<tr>
<td>SAS-VAS</td>
<td>9 mm</td>
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<td>PAS-OP</td>
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decreasing from 77 to 27 and hypopneas from 68 to 11 and snoring reduced remarkably (Figs 8 and 9, Table 3).

DISCUSSION

OSA syndrome is a common disorder that is potentially fatal and is characterized by repetitive episodes of complete or partial airway obstruction. The nonrigid upper airway consists of nasopharynx, oropharynx and hypopharynx. In normal physiology, during inspiration, the action of the diaphragm creates a negative pressure in the upper airway which is resisted by the tensor veli and tensor palatini muscles. In patients with OSA there is a reduction in the activity of these muscles resulting in decreased airway space. Patients with mandibular deficiency have a posteriorly positioned tongue further contributing to airway obstruction.

Dynamic magnetic resonance imaging (MRI) and computed tomographic (CT) scans are important diagnostic imaging modality for patients with OSA. Lateral cephalograms provide a two-dimensional picture, and is useful in the examination of the upper and lower airway dimensions in addition to other skeletal and soft tissue analysis.

CPAP despite its poor compliance continues to be the gold standard for conservative management of OSA in both adult and children. A review of oral appliance therapy for OSA by the American Sleep Disorders Association in 1995 signaled the entry of dentistry into mainstream sleep medicine. MAD and tongue restraining devices (TRD) play a role in the conservative management of mild to moderate cases of OSA. The oral appliances like MAD/mandibular repositioning device acts like a splint. It translates and holds the mandible forward, augments the activity of the genioglossus, tenses the palatoglossus, pulls the soft palate forward, decompresses the pharyngeal tissues and increases the upper airway caliber. It prevents the tongue from approaching the posterior wall of the pharynx and causing an obstruction. Titrable MAD became the dental therapy for sleep disordered breathing. Controlled studies indicate effectiveness and greater patient preference for oral appliances compared to CPAP in mild and moderate OSA. In cases treated with Herbst appliance the AHI decreased from 75.2 to 48.3 and apnea index (AI) decreased from 51 to 8. Karwetsky activator emerged as a patient friendly appliance with loop adjustments providing titration and proven initial efficacy in the management of mild to moderate OSA. Abi Ramia evaluated the effect of MAD on the volume of upper airway by CBCT and concluded that a twin block like appliance significantly changed the airway volume from 7.601 ± 2.659 to 8.710 ± 2.813 mm. In the current case report there were remarkable improvements of the symptoms with AHI reduced to 4 with improved quality of sleep and cessation of snoring. She was counselled for lifestyle modification and patient lost body weight reducing the BMI and submandibular adipose tissue. This added to further improvement and work productivity and academic performance. Hence, it can be justified that the treatment delivered to the patient presented in this case report was suitable and effective. Though a titratable MAD and CBCT would be preferable and provide detailed airway assessment.

Literature reports on associated problems with oral appliances used for the management of SRBD like OSA are the inability to reliably predict treatment outcome, uncertainty of individual advancement titration requirements and uncertainty of the type of appliance design on treatment outcome and resultant adverse effects. As any other appliance compliance to treatment and potential long-term complications of therapy are also added issues. The patient in this case report complained of discomfort for a few days and was comfortable thereafter.

CONCLUSION

• It may be concluded that MAD is often better accepted by the patients and can be a viable modality in the management of noncompliant mild to moderate cases of OSA with snoring specially in those noncomplaining to CPAP therapy.
• MAD also has the potential to be prescribed as an intermittent option for patients on long-term CPAP therapy.
• Therefore the dental surgeon/orthodontist should be recognized as a member of the interdisciplinary and multidisciplinary team of sleep disorder specialists.
• Though CPAP is the gold standard of conservative management for OSA, patient compliance remains a problem.
• Oral appliances to be included in the recommended guidelines for the management of selective cases of OSA. Oral appliances bring about improved work efficiency and better quality of life.

REFERENCES


