

# Management of obstructive sleep apnea in an edentulous patient with a mandibular advancement splint: A clinical report

Suresh Nayar, BDS, MDS,<sup>a</sup> and Jeremy Knox, BDS, MScD, PhD<sup>b</sup>  
Morrison Hospital, Swansea, Wales, United Kingdom

Literature on the treatment of obstructive sleep apnea in edentulous patients with a mandibular advancement splint is sparse. This clinical report describes a clinical and laboratory method of splint fabrication and discusses the rationale for its use. (J Prosthet Dent 2005;94:108-11.)

**O**bststructive sleep apnea (OSA) is caused by the 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.<sup>1</sup> The prevalence rises dramatically with age, to an estimated 28% to 67% for elderly men and 20% to 54% for elderly women.<sup>2</sup> The most common complaints are loud snoring, disrupted sleep, and excessive daytime sleepiness. Patients with apnea may develop cardiovascular abnormalities, such as coronary heart disease, hypertension, and stroke, because of the recurrent nocturnal hypoxemia and hypercapnia.<sup>3</sup>

Airway obstruction can occur in many areas of the nasopharynx, oropharynx, and hypopharynx.<sup>4</sup> More commonly, airway obstruction occurs in the oropharynx.<sup>4</sup> Redundant peripharyngeal tissue reduces the size of the posterior airway, which increases the chance of obstruction during sleep. An elongated soft palate and enlarged uvula may further compromise the airway. The base of the tongue is a common site of hypopharyngeal obstruction in sleep apnea.<sup>4</sup> Patients with a small or retracted mandible are at increased risk for obstruction. Occasionally, an enlarged tongue may cause obstruction. In this setting, obstruction occurs when the base of the tongue impinges on the airway just above the glottis. Diagnosis of OSA is based on the following: (1) a comprehensive history from the patient and his/her sleeping partner; (2) ear, nose, and throat examination; (3) body mass index; and (4) overnight polysomnography, which is regarded as the definitive investigation for the diagnosis of OSA, permitting the distinction between OSA and simple snoring.<sup>3</sup>

The severity of OSA is expressed as the Apnea-Hypopnoea Index (AHI) and is the number of apneas (cessation of breathing lasting 10 or more seconds) and hypopneas (50% reduction in tidal volume, accompanied by a 4% or greater fall in oxygen saturation lasting 10 seconds or more) per hour of sleep.<sup>3</sup> Due to the multifactorial nature of this condition, management in-

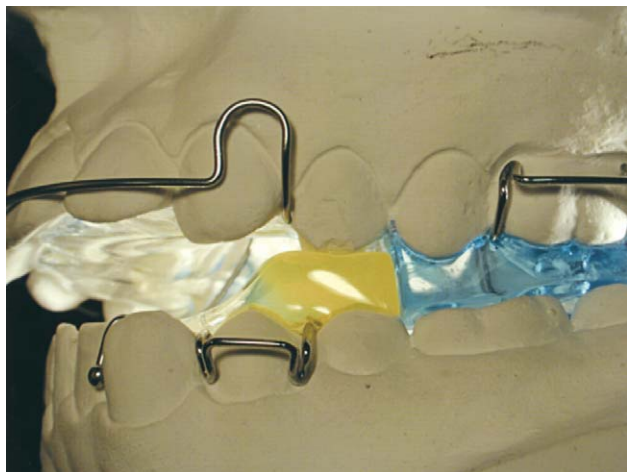
cludes a multidisciplinary approach. The team may include a thoracic physician, ear, nose, and throat surgeon, orthodontist, restorative dentist, and oral and maxillofacial surgeon. The treatment modalities consist of both surgical and nonsurgical methods. The nonsurgical approaches to treatment include weight loss, reduction in smoking and alcohol consumption, nasally applied continuous positive airway pressure (CPAP), considered to be the long-term treatment of choice and regarded as the gold standard,<sup>5</sup> and mandibular advancement splints (MAS).

Surgical interventions include: (1) genioglossus tongue advancement, (2) maxillomandibular advancement, (3) laser-assisted uvuloplasty (LAUP), (4) uvulopalatopharyngoplasty (UPPP), and (5) tracheostomy.<sup>4</sup> Treatment of OSA in dentate patients with mandibular advancement splints is well documented,<sup>6-9</sup> but for edentulous patients, a search of literature revealed few reports.<sup>10,11</sup> The objective of the mandibular advancement splint is to advance the mandible and tongue base, increasing the space between the base of the tongue and the posterior pharyngeal wall. The tongue may also be advanced with the use of a tongue-retaining device.<sup>10</sup> These appliances subsequently assist in reducing the obstruction. It has been reported that oral appliances may cause worsening of OSA in a small number of subjects.<sup>12</sup> It is imperative, then, that patients with an MAS are regularly recalled and, ideally, should also undergo a polysomnography with the MAS in situ to ensure that a satisfactory therapeutic benefit has been achieved.<sup>13</sup>

Robertson<sup>10</sup> and Meyer and Knudson<sup>11</sup> proposed that the interocclusal distance be increased by 8 mm and 5 mm from the physiological rest position, respectively. Robertson theorized that this was essential to ensure that dislodgement did not occur nocturnally. However, Johal and Battagel<sup>3</sup> noted that a mandibular advancement splint that promotes mandibular opening results in a downward and backward rotation of the mandible, with a concomitant posterior movement of both tongue and soft palate. This can negate the benefits to the airway from protrusion, resulting in the further narrowing of the pharyngeal airway. This clinical report presents the fabrication of a mandibular advancement

<sup>a</sup>Senior House Officer, Department of Restorative Dentistry.

<sup>b</sup>Consultant Orthodontist, Department of Orthodontics.



**Fig. 1.** Twin block-type appliances.

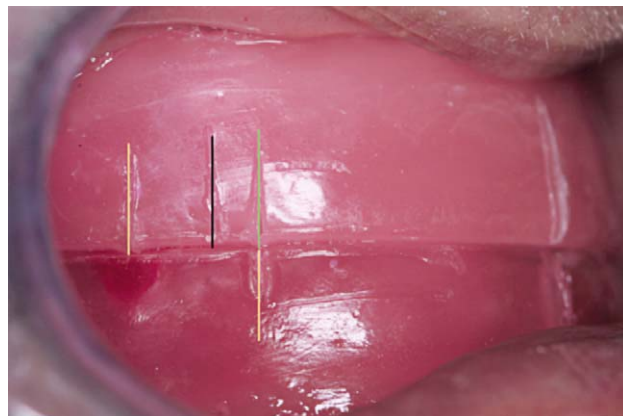
splint for an edentulous patient without an increase in the vertical dimension of occlusion.

## CLINICAL REPORT

A 49-year-old man was referred from the Ear, Nose and Throat Department (Singleton Hospital, Swansea, United Kingdom) with a history of intrusive snoring and obstruction. Sleep endoscopy showed evidence of a retrognathic mandible with marked obstruction to 68%. There was obvious tongue base collapse at rest, with an associated component from the lateral pharyngeal wall and uvula.

The patient was seen in the Department of Orthodontics at Morrision Hospital, Morrision, Swansea, United Kingdom. Radiographic examination (orthopantomogram, lateral cephalogram) revealed an edentulous patient with a Class II skeletal base relationship. In view of the retrognathic mandible, it was determined that a mandibular advancement splint should be fabricated to bring the mandible forward, which in turn would enlarge the posterior pharyngeal space.

Conventional splint designs for dentate patients include the following: (1) maxillary and mandibular vacuum-formed splints that are attached together, (2) a maxillary and mandibular combination vacuum-formed splint attached together with autopolymerizing acrylic resin, (3) a heat polymerized and latched 2-part splint, and (4) twin block-type appliances (Fig. 1).<sup>9</sup> However, since the patient was edentulous, he was referred to the Department of Restorative Dentistry (Morrision Hospital, Morrision, Swansea, UK) for fabrication of a tissue-borne mandibular advancement splint. The patient had been a complete denture wearer for 5 years. The maxillary and mandibular residual ridges were well formed.



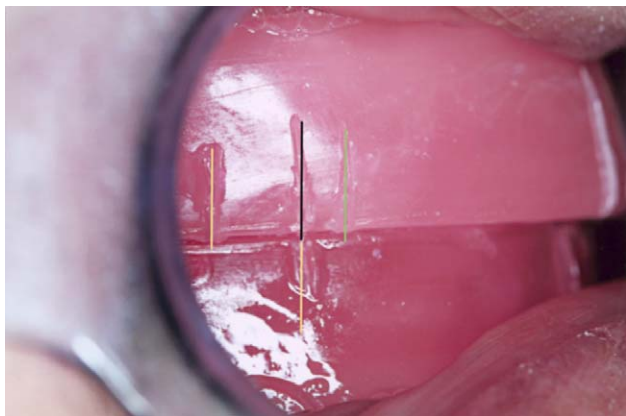
**Fig. 2.** Jaw relation at maximum protrusion. *Yellow lines* indicate centric relation marks, *green line* indicates maximum protrusion, and *black line* indicates 75% protrusion.

Maxillary and mandibular preliminary impressions were made with modeling plastic impression compound (Kerr Impression Compound; Kerr Corp, Orange, Calif). Definitive impressions were made using medium-body rubber base impression material (Provil Novo; Heraeus Kulzer GmbH, Hanau, Germany) in border-molded (Green Stick Compound; Kerr Corp) custom trays (Custom Tray Resin LC; Henry Schein Inc, Melville, NY). Particular attention was made to attain maximum functional extension of the lingual borders. Wax (Modelling wax; Kemdent, Purton, Swindon, UK) occlusal rims were then fabricated on the definitive casts.

Maxillomandibular relation was recorded maintaining the patient's existing vertical dimension of occlusion. Vertical marks were made bilaterally on both of the wax occlusion rims in the canine region at the centric relation position. The patient was then asked to protrude maximally, and another line was marked on the maxillary rim corresponding to the centric relation line in the mandibular rim (Fig. 2).

The distance between the 2 marks on the maxillary rim was ascertained, and then 75% of the distance from the centric relation line was marked on the maxillary rim. The mandibular rim was then made to occlude so that the centric relation line of the mandibular rim coincided with the 75% line (drawn as previously mentioned) in the maxillary occlusion rim (Fig. 3). The maxillomandibular relation was recorded at that position with occlusal registration paste (Futar D Occlusion; Kettenbach Dental, Eschenburg, Germany), and the casts were articulated.

After articulation, the casts were duplicated with duplicating silicone (Pourable silicone; Chaperlin and Jacobs Ltd, Surrey, UK). Vacuum-formed bases (Kombiplast soft/hard, 3 mm; Dreve Dentamid GmbH, Unna, Germany) were fabricated on the duplicated casts;



**Fig. 3.** Maxillomandibular relation at 75% maximum protrusion. Mandibular centric relation mark (yellow line) and 75% protrusion line (black line) coincide.



**Fig. 4.** Frontal view of mandibular advancement splint.



**Fig. 5.** Lateral view of mandibular advancement splint.



**Fig. 6.** Mandibular advancement splint intraorally.

these were then placed on the articulated casts, and 2 wax (Modelling wax; Kemdent) blocks were adapted on either side, in the position of the wax rims. The 2 wax blocks were then processed with heat-polymerized clear acrylic resin (Selectaplus H/Trevalon; Dentsply Caulk, Milford, UK), trimmed with tungsten carbide burs, and polished with sandpaper on a mandrel acrylic polisher (Technic polisher; Kenda AG, Vaduz, Liechtenstein) and with pumice on a rag wheel (Calico mop; Metrodent Limited, Lowergate, Huddersfield, UK). Subsequently, vent holes were placed in the middle of the heat-polymerized acrylic resin blocks, which were then adapted onto the vacuum-formed bases and sealed with autopolymerizing acrylic resin (Rapid repair self-cure repair material; Dentsply Ltd, Surrey, England) at the recorded maxillomandibular relation (Figs. 4 and 5).

Postinsertion instructions on use and care were provided at insertion of the MAS (Fig. 6). The patient was advised to wear the splint for 1 to 3 hours during the

day for the first week to adjust to the appliance. The patient was recalled 1 week later and, in view of the progress made, was then advised to start wearing the splint at night as well. At the first monthly review, the patient reported his sleep had improved at night and his daytime somnolence had diminished.

## DISCUSSION

The primary objective in fabricating this splint was to increase the space between the base of the tongue and the posterior pharyngeal wall. This was achieved by protrusion of the mandible without increasing the vertical dimension of occlusion. The authors concurred with Johal and Battagel<sup>3</sup> that increasing the occlusal vertical dimension would decrease the space between the base of the tongue and the posterior pharyngeal wall. At the same time, it was also important to ensure that the mandible did not disengage from the splint and fall

back during sleep, thus negating the purpose of the splint. This was accomplished by making a mandibular impression with a properly extended lingual flange.

The advantage of this technique is its simplicity, as the clinical procedures are similar to those for fabricating a conventional complete denture. Moreover, since the vertical dimension of occlusion is not increased, there was no difficulty in inserting and removing the splint from the mouth, and the patient did not find the splint formidable to wear. This assisted in improved patient compliance. There was no reported dislodgement of the splint during sleep with this patient. This single-piece splint would be difficult to insert and remove in patients who have a reduced mouth opening. In such situations, a 2-piece splint based on the principle used in this article might be more pragmatic. Even though the patient reported a favorable sleeping pattern, ideally, the patient should have undergone a polysomnography with the MAS in situ to have an objective measurement of respiration during sleep. This was not performed, and the lack of regular follow-up is a limitation of this reported treatment.

## SUMMARY

This article describes the management of obstructive sleep apnea in an edentulous patient with a mandibular advancement splint. The method of splint fabrication and rationale were discussed.

## REFERENCES

1. Young TM, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. *New Engl J Med* 1993;328:1230-5.
2. Garcia-Rio F, Racionero MA, Pino JM, Martinez I, Ortuno F, Villasante C, et al. Sleep apnea and hypertension. *Chest* 2000;117:1417-25.

3. Johal A, Battagel JM. Current principles in the management of obstructive sleep apnoea with mandibular advancement appliances. *Br Dent J* 2001; 190:532-6.
4. Victor LD. Obstructive sleep apnea. *Am Fam Physician* 1999;60:2279-86.
5. Sullivan CE, Issa FG, Berthon-Jones M, Eves L. Reversal of obstructive sleep apnoea by continuous positive airway pressure applied through the nares. *Lancet* 1981;1:862-5.
6. Knudson RC, Meyer JB Jr, Montalvo R. Sleep apnea prosthesis for dentate patients. *J Prosthet Dent* 1992;68:109-11.
7. Sadan A, Novoselsky A, Rogers WA. An alternative technique for mandibular advancement prosthesis fabrication. *J Prosthodont* 1998;7:40-4.
8. Lyons MF, Cameron DA, Banham SW. Snoring, sleep apnoea and the role of dental appliances. *Dent Update* 2001;28:254-6.
9. Ellis SG, Craik NW, Deans RF, Hanning CD. Dental appliances for snoring and obstructive sleep apnoea: construction aspects for general dental practitioners. *Dent Update* 2003;30:16-26.
10. Robertson CJ. Treatment of obstructive sleep apnoea in edentulous patients—design of a combination appliance: a case study. *N Z Dent J* 1998;94:123-4.
11. Meyer JB Jr, Knudson RC. Fabrication of prosthesis to prevent sleep apnea in edentulous patients. *J Prosthet Dent* 1990;63:448-51.
12. Gale DJ, Sawyer RH, Woodcock A, Stone P, Thompson R, O'Brien K. Do oral appliances enlarge the airway in patients with obstructive sleep apnoea? A prospective computerised tomographic study. *Eur J Orthod* 2000;22:159-68.
13. Practice parameters for the treatment of snoring and obstructive sleep apnea with oral appliances. American Sleep Disorders Association. *Sleep* 1995;18:511-3.

### Reprint requests to:

DR SURESH NAYAR  
DEPT OF RESTORATIVE DENTISTRY  
CHARLES CLIFFORD DENTAL HOSPITAL  
WELLESLEY ROAD  
SHEFFIELD, UNITED KINGDOM  
S10 2SZ  
FAX: +44 114 271 7993  
E-MAIL: suresh.nayar@sth.nhs.uk

0022-3913/\$30.00

Copyright © 2005 by The Editorial Council of *The Journal of Prosthetic Dentistry*.

doi:10.1016/j.prosdent.2005.05.006

### Bound volumes available to subscribers

Bound volumes of *The Journal of Prosthetic Dentistry* are available to subscribers (only) for the 2005 issues from the publisher at a cost of \$92.00 (\$106.00 international) for Vol. 93 (January-June) and Vol. 94 (July-December). Shipping charges are included. Each bound volume contains a subject and author index. The binding is durable buckram with the journal name, volume number, and year stamped in gold on the spine. *Payment must accompany all orders.* Contact Elsevier Inc., Subscription Customer Service, 6277 Sea Harbor Dr, Orlando, FL 32887, or call 800-654-2452 or 407-345-4000.

**Subscriptions must be in force to qualify. Bound volumes are not available in place of a regular Journal subscription.**