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CLINICAL REPORT

Oral Appliance for the Treatment of Severe Obstructive Sleep Apnea in Edentulous Patient

Marcele Jardim Pimentel · Ataís Bacchi · Gabriela Cassaro de Castro · Célia Marisa Rizzatti-Barbosa

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Abstract Oral appliances have attracted interest for the treatment of mild and moderate obstructive sleep apnea (OSA) and the mandibular repositioning device (MRD) or a tongue-retainer device (TRD) is usually indicated to increase the upper air space. Describes a combination of MRD (with 60 % maximum mandibular protrusion) and TRD to treat severe OSA. Polysomnography (PSG) and two questionnaires: the Epworth Sleepiness Scale (ESS) and the Pittsburgh Sleep Quality Index (PSQI) evaluated the sleep pattern in two times (after and before the use of oral appliance). The initial PSG exam was compatible with diagnoses severe OSA and the Apnea–Hypopnea Index was 40.4, and 54 % oxygen saturation $-spO^2$. The ESS and PSQI scores were 11 and 6, respectively. After she began wearing the device she stopped snoring, her Apnea–Hypopnea Index decreased to 17.6, presented a sleep efficiency of 81.6 % and had a 77 % spO^2. The ESS and PSQI scores dropped to three. MRD in association with the tongue-retainer was effective in reducing the severity of the apnea for this edentulous patient.

Keywords Sleep apnea · Oral appliance · Sleep disturbance

Marcele Jardim Pimentel—MSc, PhD Student of State University of Campinas (UNICAMP) and Specialist in Dental Prosthesis of University of Sao Paulo (USP), Bauru, SP, Brazil.

M. J. Pimentel (✉) · A. Bacchi · G. C. de Castro · C. M. Rizzatti-Barbosa
Department of Periodontology and Prosthodontics, Piracicaba Dental School, State University of Campinas (UNICAMP), Av. Limeira, 901, Caixa Postal 52, Piracicaba, SP 13414-903, Brazil
e-mail: marcelejardim@gmail.com

C. M. Rizzatti-Barbosa
e-mail: rizzatti@fop.unicamp.br

Introduction

Obstructive sleep apnea (OSA) is a respiratory disorder characterized by repeated collapse of the upper airway and cessation of breathing during sleep [1]. It is usually associated with snoring. Both are caused by partial or complete collapse of the pharyngeal airway during sleep due to a combination of a reduction in muscle tone at sleep onset and structural factors such as obesity, retrognathia, tonsillar hypertrophy, and macroglossia [2]. There are three kinds of apnea: OSA (blockage of air space); central sleep apnea (there is no blockage, but the brain fails to give the muscles to the signal to breath); and mixed apnea (a combination of these two conditions), all diagnosed by polysomnography [3].

The prevalence of OSA ranges from 9 to 28 % [4], and it is higher in the elderly population (62–81 %) [5]. In this age group, edentulous patients are common, and an atrophic mandible associated with poor retention may cause difficulty into retaining the appliance [6]. Edentulous patients present changes in facial anatomy [7, 8], and reduced upper air way [9]. They also are more likely to be affected by severe medical complications due to low oxygen saturation, such as hypertension, coronary heart disease and stroke, as a result of recurrent nocturnal hypoxemia and hypercapnia [3, 10, 11].

In recent years, oral appliances (OA) have attracted considerable interest in the treatment of snoring and OSA [12]. There are two types of OA: the mandibular repositioning device (MRD), which retains the advancing mandible, and the tongue-retainer device (TRD) which is designed to keep the tongue in an anterior position during sleep by means of negative pressure [12–15].

Edentulous patients may not be ideally suited for treatment with a MRD because they may not have enough intraoral retention to keep the appliance in the mouth

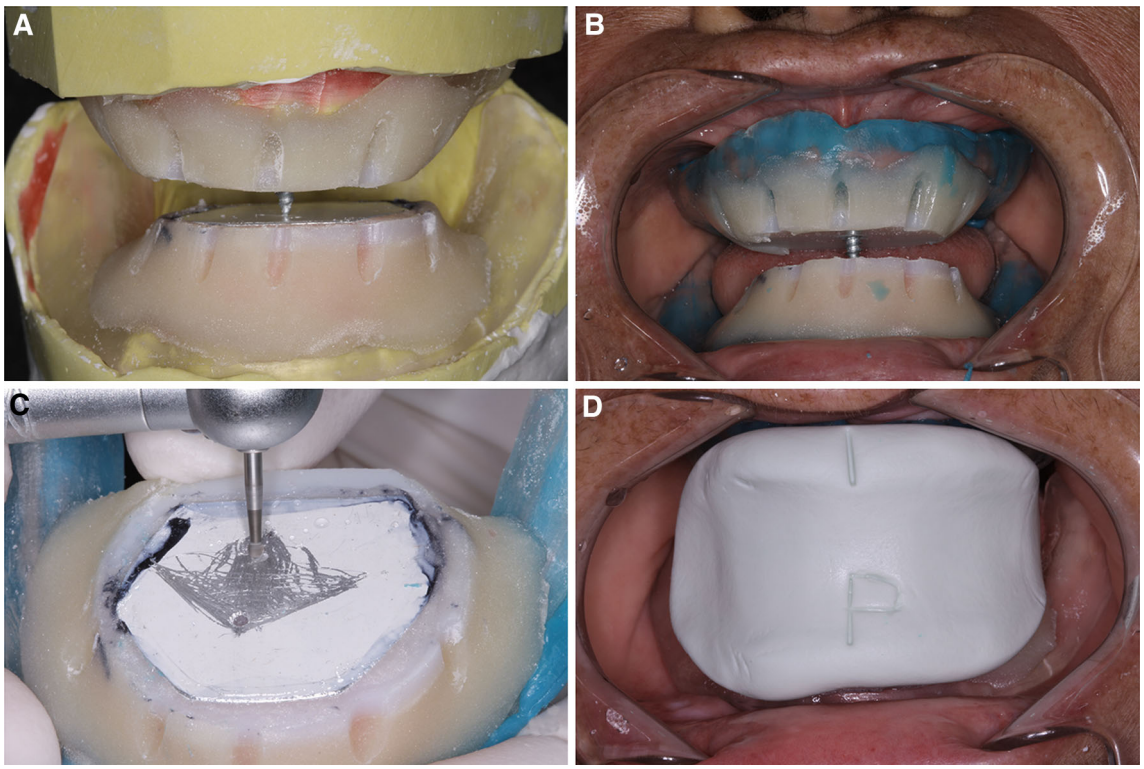

Fig. 1 Protrusion register. **a** Acrylic bases (metallic desk in jaw base and screw fixed in maxilla base), **b** Positions recorded on a metal deck fixed in the mandibular base, **c** Drawing of mandibular movements. Manufacture of perforation to accommodate the screw and record the position. **d** Record the relation between maxilla and mandibular with dense silicone

during sleep [16]. The tongue may also be advanced with the association with a TRD. The treatment of OSA in dentate patients is well-documented, but for edentulous patients, a search of the literature reveals few reports [6, 10]. This clinical report describes the use of an appliance combination of MRD and TRD with a custom made tongue-tip housing for an older edentulous female patient with severe OSA.

Clinical Report

A 64-year-old woman was referred from the Piracicaba Dental School, State University of Campinas with a complaint of obstructive sleep apnea. The history revealed severe snoring, daytime drowsiness, poor sleep quality by Pittsburgh Sleep Quality Index (PSQI) with score 6 and an Epworth Sleepiness Scale (ESS) score of eleven. The patient said that she snored in any sleeping position, had morning headaches, and suffered from dryness in the mouth. She had used medication for some time to sleep, but did not use alcohol or smoke. She had no hypertension or diabetes mellitus.

The polysomnography exam showed an Apnea–Hypopnea Index (AHI) score of 40.4 (245 respiratory events: 14 central apnea, 128 obstructive apnea, 19 mixed apnea, and 84 obstructive hypopnea), the minimum oxygen saturation was 54 %, and the sleep efficiency was 83.7 % with continuance of REM sleep of 49 min. These data were compatible with a severe syndrome of OSA diagnosis [16].

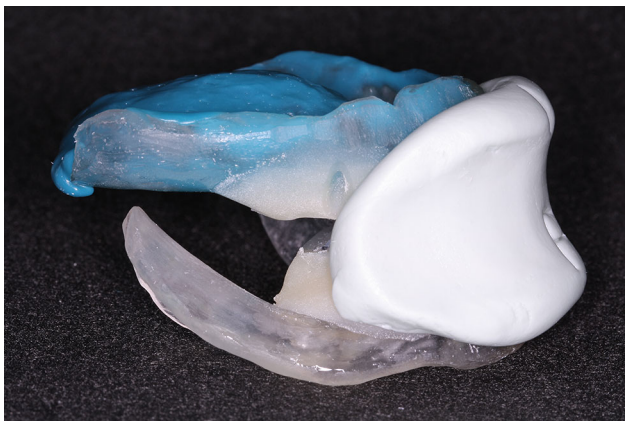

Fig. 2 Register of the protrusion position with silicone

The patient was initially subjected to medical treatment with nasal continuous positive airway pressure (CPAP) but she reported nasal congestion, suffocation, and eye discomfort and was then referred to a dentist for evaluation of

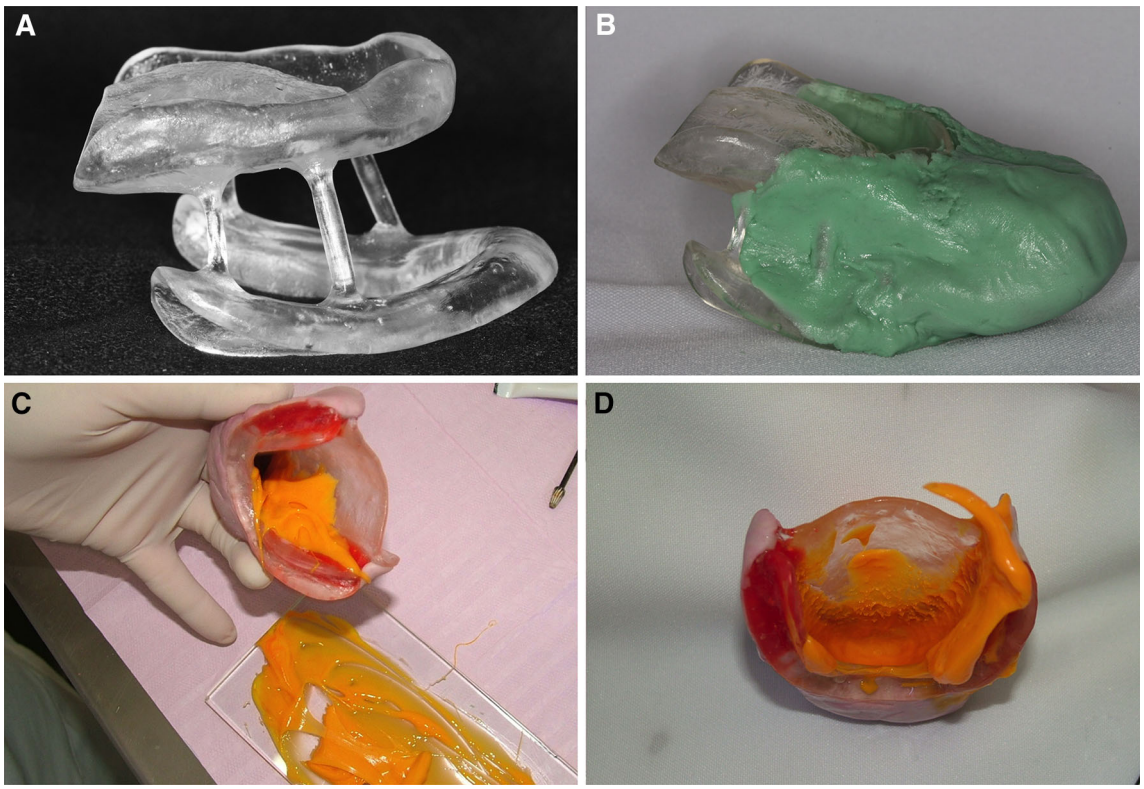

Fig. 3 Tongue impression. **a** Oral appliance in acrylic resin with fixed position of vertical dimension and percentage of protrusion, **b** Make a barrier with dense silicone to serve like housing to tongue impression, **c** Using soft silicone to tongue impression, **d** Final mold

the possibility of treatment with an oral appliance. The patient was totally edentulous and had worn complete dentures for 15 years. Thus, a combination of the MRD and TRD to enlarge the posterior pharyngeal space was performed [10]. An acrylic tongue housing projection (vacuum) on the anterior of the appliance also was created. We chose this personalized appliance to create more contact of the tongue superficies with the appliance to improve retention. This can be important in the absence of the teeth and ward off the soft tissue of the posterior wall. Preliminary impression was made with an irreversible hydrocolloid material using stock trays. Wax rims were made to register the occlusal vertical dimension. This point is so relevant to prove more space in upper airway space. Acrylic bases were made to record the maximum mandibular protrusion according to the Gysi register [17] (Fig. 1).

This record allows the patient perform lateral and protrusive movements, which are recorded in a metallic table with the aid of screw fixed to the acrylic base in the maxilla. This maximum protrusion registered in month will be the reference to advancement of the mandible. The distance between the maximum mandibular protrusion, and the maximum retrusion was 12 mm. The mandible horizontal position was obtained by a 40 % (4.8 mm) reduction of this total measure, and this position was demarcated by drilling made in the deck, where the maxillary screw was fixed. It resulted in a mandibular advancement of 60 % from the possible maximum. This position was recorded by condensation silicone and transferred to a semi-adjustable articulator (Fig. 2). New bases were made and linked in this new protruded mandibular position, and an anterior heavy silicone projection was created in the bases to reproduce the impression of the tongue (Fig. 3a, b). The silicone housing was filled with fluid silicone and placed in the patient's mouth. The patient was told to bite the device in the right position and insert her tongue into the compartment filled with the impression material to obtain the final mold (Fig. 3c, d).

The impression was included and processed with thermopolymerized acrylic resin (Vipi Cril/Vipi Pirassununga, Sao Paulo, Brazil). The appliance was polished with camborundum sandpaper (A320 and 280). In the installation, an adjustment was made to prevent injuries (Figs. 4, 5). The patient was given instructions regarding proper care, use, hygiene, and correct appliance positioning.

After a week, she reported that the appliance was comfortable. She had stopped snoring and had seen improvements in sleeping time. Furthermore, 3 months after appliance installation, the patient was subjected to a new

Fig. 4 Oral appliance in mouth front view

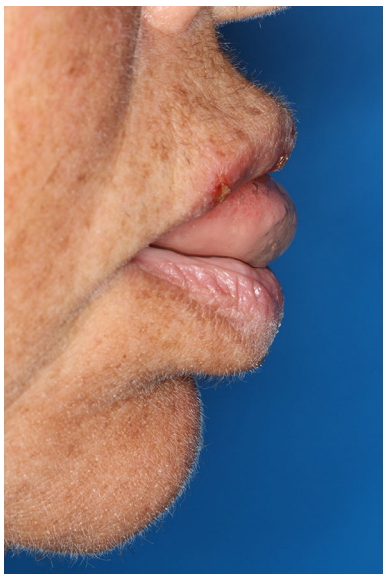

Fig. 5 Oral appliance in mouth lateral view

Table 1 Polysomnography sleep evaluation before and after use of oral appliance during sleep (period of treatment with oral appliance 3 months)

	Before (18 Jan 2010)	After (18 Oct 2010)
Apnea–Hypopnea Index	40.4	17.6
Central apnea	14	1
Obstructive apnea	128	36
Mix apnea	19	5
Obstructive hypopnea	84	71
Epworth	11	3
Pittsburgh Index	6	3

polysomnography exam with the appliance, and the results showed the following: the AHI decreased to 17.6 (113 respiratory events: 1 central apnea, 36 obstructive apnea, 5 mixed apnea, and 71 obstructive hypopneas), the minimum oxygen saturation increased to 77 % and sleep efficiency was 81.6 % and there was an increase in REM sleep to 92.5 min. These data were compatible with a moderate syndrome of OSA diagnosis [16]. The ESS and PSQI scores decreased, too, as shown in Table 1. Body weight measurement is always recommended in apnea treatment, and she dropped 4 kg in 3 months after the installation of the appliance. However, her body mass index showed a slight reduction of 32.7–31.6 kg/m^2, remaining at obesity grade 1.

Discussion

Reports of apnea appliances are made on dentate patients, and the teeth are used for retention [1, 18]. However, it is more difficult to perform retention in totally edentulous patients. The literature considers a mandibular advancement to about 75 % of the possible maximum [12], but this measure was reported for dentate patients. Previous study reported [10] similar measurement (75–85 %) to an edentulous, however, the rigid fixation of the appliance is difficult without a teeth retention [6]. In our case, a reduction of the maximum protrusion was necessary to stabilize the device, so 60 % of the maximum protrusion was used, which is the minimum advance necessary to give positive results [19]. Retention of the appliance is a critical point in edentulous patients [6] and must be achieved for OSA treatment to be effective. Thus, a reduction in the protrusion was necessary to avoid displacement of the appliance. Therefore, tongue-retaining is important to hold the tongue and maintain the posterior air space [3, 20, 21].

Compared with the CPAP, the oral appliance seems to be slightly less effective [12, 22]. However, some clinical studies have shown that the CPAP has more side effects and is poorly tolerated by some patients [12, 23, 24]. A crossover study compared the two treatments and concluded that OA decreased apnea's signals and symptoms but the CPAP was more effective despite the fact that the patients experienced more severe side effects [12].

Our patient presented favorable alveolar ridges and reported no discomfort or instability during appliance usage. The reestablishment of the vertical dimension is important to achieve device stability [25]. The TRD showed good results [3, 13, 20] and has the advantage of MRD because it can be used in edentulous patients [3]. Therefore, it is important to keep the tongue in a more anterior position. The impression of the tongue improved the negative pressure efficacy and device stability. However, this kind of device should be contraindicated for patients with nasal airway obstruction because it blocks oral ventilation; our patient did not experience any respiratory discomfort.

The main advantages of this treatment: it is a simple and non-invasive procedure, reversible, easy to clean, and comfortable. Some side effects reported by the literature include sore jaw muscles, excessive salivation, and chewing difficulties in the morning [12]. In this clinical case, the patient reported excessive salivation only in the first few days. Some reported cases indicated a large amount of protrusion [6, 12, 26], but they were not associated with effective tongue retaining. In this case, a smaller protrusion is proposed only if associated with tongue retaining.

This appliance works only if the suspect site of the obstruction is at the level of the base of the tongue and the posterior pharyngeal wall [6]. The effectiveness of the use of an oral appliance for treating severe sleep apnea has not yet been established [12], but in this clinical case, the results were positive since improvements were obtained according to the ESS, PSQI, and polysomnography even in the presence of obesity. It is known that cures for apnea is yet unpredictable, but some treatments can provide improvements, as shown in this case.

Conclusion

The association of the reestablish of oral vertical dimension with the MRD and TRD appliance with 60 % protrusion decreased apnea's signs and symptoms, providing good improvements in treating an edentulous patient with severe apnea.

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Conflict of interest None.

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