Use of an occlusal splint to treat temporomandibular joint pain during treatment of sleep apnea with an oral appliance

Utilizzo di uno splint occlusale per trattare una disfunzione dell’articolazione temporo-mandibolare in corso di trattamento con protesi endorale per una sindrome delle apnee ostruttive nel sonno

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ABSTRACT
This paper reports the case of an occlusal splint used to relieve pain in the temporomandibular joint (TMJ) and masticatory muscles caused by a mandibular repositioning appliance (MRA) during treatment of obstructive sleep apnea (OSA). When the patient reported limited jaw movement and joint pain, an occlusal splint was fabricated and sequential adjustments were made until the pain disappeared and jaw movement returned to normal. Treatment with the occlusal splint lasted 105 days and the patient was able to continue OSA treatment. The TMJ became stable, without pain and the apnea/hypopnea index went from 16.0 to 0.4 events per hour. It is very important for dentists to have sufficient expertise in treating temporomandibular disorder when treating OSA with oral appliances. We conclude that it is possible to deal with these situations and allow patients to complete their OSA treatment.

Key words: Occlusal splints, oral appliance, sleep apnea.

INTRODUCTION
Since oral appliances (OA) were introduced as an option for the treatment of obstructive sleep apnea (OSA), many designs have been developed and their efficacy has been proven in a large number of studies in the current literature [1,2]. Considering
the anatomic site where OSA occurs, dentistry may play an important role in the treatment of this syndrome and improved lifespans. The biomechanics of an OA basically consist of positioning the mandible forward, which allows changes in upper airways, thereby increasing the dimensions of the pharynx and adjacent structures. An OA is considered the first treatment option for snoring, upper airway resistance and mild OSA. Moderate and severe OSA can be treated with an OA when patients do not tolerate the positive airway pressure (PAP) device [1]. Treatment with an OA is preferred by patients with OSA, even those with severe OSA, perhaps due to the ability to adjust the devices over time for improved efficacy [3,4]. Like any therapy, treatment with an OA also has inconveniences, but most are short-term problems that decrease in two weeks to six months and are well tolerated by patients. The most common short-term side effects are dry mouth, excessive salivation, temporomandibular joint/muscle discomfort and tooth discomfort in the morning. These short-term symptoms occur in the majority of OA users [5-7]. However, there are few reports on long-term side effects related to the temporomandibular joint (TMJ) and masticatory muscles [8,9]. A significant number of studies report that mandibular advancement seems to be innocuous to the TMJ of patients with OSA [5,10,11]. The aim of this short communication is to share our experience in treating joint and muscle pain during OSA treatment with an OA, which allowed the patient to continue her treatment without pain.

CASE DESCRIPTION AND RESULTS
A 42-year-old woman, with a body mass index (BMI) of 23 kg/m², was referred to our dental office within the University Faculty by a sleep disorder specialist physician for OSA treatment with an OA. The polysomnogram (PSG) showed abnormal physiological variables. The apnea/hypopnoea index (AHI) was 16.0 per hour. During the initial interview, the patient's medical history was taken. The patient reported the occurrence of problems caused by snoring, arrested nocturnal breathing, drowsiness upon waking, fatigue, mood swings and memory lapses. She also reported that she was divorced and her children complained about the noise of her snoring every night. The interview revealed that the patient suffered from anxiety and had periods of depression. Facial muscle palpitation and TMJ auscultation revealed no pain, but there was a click in the right side during mouth opening, suggesting disc displacement with reduction, which is characterized by an opening click as the disc returns to a more normal position. The total advancement of the mandible and total mouth opening were 10.5 mm and 45.0 mm, respectively. The oral evaluation revealed good periodontal health, the presence of all dental elements and signs of tooth wear, indicating the presence of teeth grinding.

The Ethics Committee of the University approved the study (protocol number H285/CEP/2001) and the patient gave her informed consent. Impressions of the upper and lower arches were made and sent to a specialized laboratory for the making the OA. The appliance chosen was the PMPower, constructed with an advancement of 65% of total protrusion (Figure 1). The placement of the mandibular repositioning appliance (MRA) was accomplished with instructions regarding the care and hygiene of the device. After one week of device usage, adjustments (0.50 mm) were performed weekly in order to prevent TMJ and muscle pain. A follow up PSG with the OA in situ was scheduled for when the patient completed six months of device usage. After two months of OA usage, the patient returned to the dental office complaining of pain in the TMJ region and limited jaw movement. She reported the sudden onset of pain and stated she could no longer use the OA.

The patient had lock jaw, suggesting anterior displacement without reduction. Due to this complication, an occlusal splint was made from rigid acrylic resin and the patient was instructed to use it full time until she could wear the OA again and continue the OSA treatment. Adjustments were made every two weeks in order to achieve muscle stability and pain relief. Simultaneous occlusal contact of all mandibular supporting cusps was determined using articulation paper (thickness: 12 mm). During lateral excursion and protrusive movements, the canine guidance caused discusion of all teeth. The patient reported a decrease in pain after 10 days of the occlusal splint usage. There was a complete disappearance of pain after 45 days, but with an insufficient improvement in jaw movement. The next step was a mandible rotation adjustment in order to obtain a larger space between articular fossa and condyle in order to reposition the disc. This adjustment was made by adding acrylic resin to the last dental contact of the occlusal splint in the molar region. The other teeth had no contact with the splint, which resulted in a counter-clockwise rotation of the mandible, thereby allowing sufficient space for disc repositioning. With this adjustment, jaw movement returned to normal after 105 days and the treatment of OSA with an OA could be continued. Jaw movement was restored and joint and muscle pain was eliminated. All stomatognathic functions could be performed naturally. After the
normalization of the TMJ and facial muscles. OSA therapy with OA was continued and another PSG was performed after six months. The AHI had decreased from 16.0 to 0.4 and, according to the patient’s report, subjective symptoms had diminished while her children reported that the snoring had greatly reduced. The patient was instructed to have periodic appointments in order to evaluate the subjective symptoms, TMJ status, the OA and its adaptation. After two years, the patient underwent another PSG, in which AHI was 1.0 events per hour. The patient reported having no symptoms of temporomandibular disorder (TMD) during this period.

DISCUSSION
This case demonstrates that, although rare, complications such as discomfort or pain in the masticatory muscles/TMJ may occur due to OA usage for OSA. This condition can be treated with an occlusal splint, thereby avoiding the abandonment of OSA treatment. Short-term side effects are common during treatment with a mandibular repositioning appliance in patients with OSA, such as facial muscle pain, TMJ discomfort, excessive salivation and transient discomfort upon awakening, but with regular OA usage and adjustments, these symptoms subside [12,13]. In some patients, muscle/joint pain may be the reason for discontinuing treatment [8]. However, no studies were found on how to treat TMJ problems when treating OSA with an OA so that patients can complete their treatment pain free. In the case reported here, the use of an occlusal splint relieved TMJ/masticatory muscle pain and eliminated the limitation to mouth opening, thereby allowing the patient to continue OSA treatment with an OA.

These results corroborate accounts in the literature that demonstrate the use of occlusal splints to treat symptoms of temporomandibular dysfunction [14,15]. These splints are also known as “splints for muscle relaxing”, “repositioning splints” or “stabilizing splints” [16]. Furthermore, we hypothesize that joint/muscle pain and clicking disappeared due to the increase in the vertical dimension induced by the occlusal splint, which simultaneously caused an increase in the joint space, thereby allowing the decompression of TMJ structures [17]. It should be stressed that, even after two years of OA usage, TMJ symptoms had not returned. We may therefore speculate that the therapeutic mechanism for decreased TMD symptoms during OA usage is similar to that during the use of a repositioning splint for relieving TMD symptoms [17]. Both devices induce mandibular protrusion with a minimal increase in the vertical dimension, which allows joint decompression and creates space for disc repositioning. A meta-analysis review established that repositioning splints were very effective in the treatment of TMD symptoms [17]. Continued OA usage may help TMJ maintenance over the years in the majority of patients. The findings reported here raise questions that should be answered with further studies. However, other studies have demonstrated that the efficacy of occlusal splints in reducing masticatory muscle activity remains questionable [18,19]. A study using magnetic resonance imaging found no change in the TMJ after one year of OA usage and another study found no change in the position of the condyle after seven years of OA usage [10,11]. Holmgren et al. state that the therapeutic mechanisms of occlusal splints are not yet completely elucidated [20]. However, it is suggested that these splints eliminate occlusal interference and interrupt

| TABLE I: PSG FINDINGS AT BASELINE, AFTER 6 MONTHS AND AFTER 2 YEARS OF OA USAGE |
|-------------------------------|-----------|-----------|-----------|
| PSG parameters              | Baseline | 6 months | 2 years  |
| AHI                          | 16.0      | 0.4       | 1.0       |
| SaO2 nadir (%)              | 87.0      | 90.5      | 90.0      |
| NREM1 (%)                   | 100.0     | 60.0      | 55.0      |
| NREM2 (%)                   | 69.1      | 55.0      | 57.0      |
| NREM3 (%)                   | 12.5      | 18.5      | 17.2      |
| REM (%)                     | 18.4      | 20.5      | 20.3      |
| Sleep Efficiency (%)        | 81.3      | 89.1      | 90.0      |

Definition of abbreviations: AHI, apnea/hypopnea index; SaO2, minimal oxyhemoglobin desaturation; NREM1, sleep stage 1; NREM2, sleep stage 2; NREM3, sleep stage 3; OA, oral appliance; PSG, polysomnogram; REM, rapid eye movement sleep stage.
the feedback mechanism, thereby relieving symptoms of TMD [17].

CONCLUSIONS

We believe that sleep dentists should have considerable expertise in the treatment of TMD in order to successfully manage joint and facial pain during the treatment of obstructive sleep apnea using an oral appliance. We conclude that it is possible to provide relief from TMJ pain and other complications due to mandibular advancement in the OSA treatment with OA. The patient described here continued OSA treatment and achieved a decrease in AHI from 16.0 to 0.40 after six months, with a slight rise to 1.0 after two years.

CONFLICT OF INTEREST STATEMENT: Neither author has any conflict of interest to declare in relation to the subject matter of this manuscript.

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