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Case report

Effectiveness of Maxillomandibular advancement (MMA) surgery in sleep apnea treatment: Case report☆

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ABSTRACT

Obstructive sleep apnea (OSA) is characterized by episodes of pharyngeal collapse during sleep. Craniofacial alterations such as retrognathia are often found in OSA patients. Maxillomandibular advancement (MMA) surgeries increase the pharyngeal space and are a treatment option for OSA. The aim of this study was to present a successful case of MMA surgery in the treatment of OSA. A patient with moderate OSA (apnea-hypopnea index (AHI)=25,2) and mandibular retrognathism and Maxillomandibular asymmetry underwent MMA surgery. The apnea-hypopnea index (AHI) were considerably improved after six months (IAH =6,7) and one year of treatment (IAH=0,2).

1. Introduction

Obstructive sleep apnea syndrome (OSAS) is characterized by obstructive events of the upper airway (UAW) during sleep, which can be associated with clinical signs and symptoms such as snoring, excessive daytime sleepiness, impaired memory, and fatigue [1].

Although CPAP is the first choice for treatment of OSAS in adults, 17–54% of patients do not take this therapy for long periods [2]. Because of low compliance of CPAP, other forms of treatment, such as maxillomandibular advancement (MMA) surgery, were suggested as an alternative for CPAP and tracheostomy in the treatment of OSAS [2,3]. It is an alternative to severe OSA treatment in patients with maxillomandibular abnormalities, and patients with mild and moderate OSAS there are other treatment alternatives.

A meta-analysis of 22 studies (627 subjects with OSA) determined that MMA is highly effective with a mean decrease in AHI from 64/h to 11/h ($\mathbf{P} < 0.001$) with pooled surgical success and cure (AHI < 5/h) rates of 86% and 43%, respectively [18].

OSAS patients have diminished UAW dimensions associated with maxillomandibular abnormalities[4]. Imaging tests such as cone beam computed tomography (CBCT) have shown that the UAW is significantly smaller in patients with OSAS [5]. For the other hand, MMA surgery increased the anteroposterior and lateral dimensions of the upper airway from the level of the hard palate to the hyoid bone [6]. When MMA and chin advancement are combined into a single surgical procedure, forward displacement of the soft palate, base of the tongue, hyoid bone, and anterior wall of the pharynx occurs, increasing the volume of the nasopharynx (NP), oropharynx (OP) and hypopharynx (HP) [7].

The purpose of this case report is to present the changes in the AHI and the volumetric changes in the UAW in a patient with severe OSAS treated with MMA surgery and advancement genioplasty.

2. Case report

Patient ERM (29 years old, Caucasian, with a body mass index (BMI) of 24.93 kg/m^2) consulted the otorhinolaryngology service for treatment of sleep disturbances. His main complaints were snoring (visual analog scale of 10 cm =8 - held by his wife), breathing pauses during the night observed by his partner, excessive daytime sleepiness (Epworth score =12), and fatigue.

A complete polysomnographic evaluation was recommended, according to the American Academy of sleep Medicine (AASM) (2007) guidelines and considering the recommended rule for hypopnea. The patient showed an apnea-hypopnea index (AHI) of 30.8. The patient was referred for treatment with CPAP but was intolerant to its use after a few months.

MMA surgery and advancement genioplasty were indicated due to a mandibular anteroposterior deficiency and maxilomandibular asymmetry (Fig. 1). On clinical examination, the patient showed Angle Class

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Fig. 1. Facial features pre-treatment.

II malocclusion, transverse maxillary atresia, a bilateral crossbite, and a modified Mallampati classification of 4 (Fig. 2).

The patient was then referred for preoperative orthodontic treatment. The Epworth Sleepiness Scale (ESS), an overnight polysomnographic evaluation, and CBCT were performed before treatment, after orthodontic treatment, and one year after MMA surgery. A polysomnographic evaluation and the ESS were also administered six months after the surgery. The patient signed an informed consent form for the proposed treatment, and the guidelines of the Declaration of Helsinki were followed.

A complete polysomnographic evaluation was performed using a digital system (EMBLA® S7000, Embla Systems, Inc., Broomfield, CO, USA) according to the manual of the American Academy of Sleep Medicine (2007) [8]. The hypopnea stage was defined according to the recommended rule (AASM, 2007) [8].

CBCT was performed at a specialized radiological center using i-CAT® imaging equipment (Imaging Sciences International, Hatfield, PA, USA). All images were calibrated using the following parameters: 36.90 mA, 120 kVp, an exposure time of 40 s, an extended height field of view (FOV), a voxel resolution (volume element) of 0.3 mm, a resolution of 1024×1024 pixels, and 12 bits per pixel. During image acquisition, the individual remained in a seated positioned with the Frankfurt plane parallel to the ground and the midsagittal plane perpendicular to the ground, with his lips at rest. The image acquisition extended from 2 cm above the glabella to the lower region of the head (chin and neck), including the inferior border of the fourth cervical vertebra (C4). Axial sections (0.3 mm thick) were obtained and exported in the Digital Imaging and Communication in Medicine (DICOM) format. The Dolphin Imaging® 3-D software, version 11.5 (Dolphin Imaging & Solutions, Chatsworth, CA, USA), was used to process and manipulate the volumetric data (DICOM files) of the NP, OP, and HP to assess the total volume (TV) selected from these predefined structures and the position and changes of the most constricted airspace segment (smallest area - SA). A postoperative CBCT evaluation was performed 12 months after the MMA surgery, while polysomnographic evaluations were performed at six and 12 months after the MMA surgery. The points and lines used to define the region evaluated are described in Fig. 3.

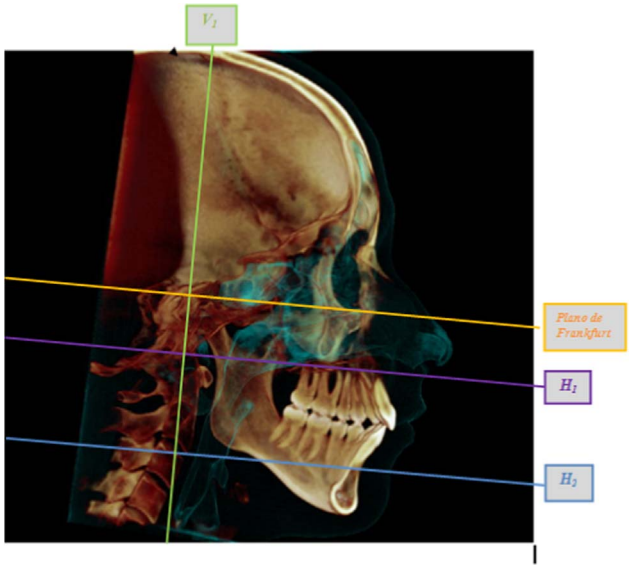

Fig. 3. Demarcation of the regions on a CBCT image.

- Upper limit of the OP: a line parallel to the Frankfurt plane passing through the ***Basion (Ba)***, which is termed ***Horizontal 1 (H_1)***;
- Lower limit of the OP: a line parallel to the Frankfurt plane passing through the most ***anterior-inferior border of the third cervical vertebra (C3)***, which is termed ***Horizontal 2 (H_2)***;

The linear measurements were also evaluated in two dimensions, both in the sagittal plane (anteroposterior measurement) and in the coronal plane (lateral measurement). For this purpose, the following points and lines were used according to [7] (Fig. 4A, B):

- PP line: continuation of the palatal plane
- SASP line: smallest area of the soft palate
- SRLA line: smallest retrolingual area
- C3 line: a line passing through the inferior border of the C3

3. Results

The duration of the preoperative orthodontic treatment was 18 months and the patient was treated with CPAP during this period. Fig. 5 shows the facial condition after orthodontic treatment and before MMA surgery. After the completion of orthodontic treatment, the patient exhibited the following characteristics: BMI=24.4 kg/m^2, AHI=25.2/h, ESS=11, TV=15967.6 mm^3, and SA=101.7 mm^2 (Tables 1,2, Fig. 6).

In the MMA surgery and advancement genioplasty, the following bone movements were performed: maxillary anterior repositioning of

Fig. 2. Intraoral features pre-treatment.