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Original Article

Maxillomandibular Advancement for Obstructive Sleep Apnea

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Abstract

Objective: We aimed to present our clinical experience with maxillomandibular advancement (MMA) for the treatment of obstructive sleep apnea (OSA) syndrome and to compare our results with literature data. **Materials and Methods:** The patients who were operated for OSA in the last 10 years were included in the study. A detailed patient's charts review was retrospectively performed. Inclusion criteria were to be available with preoperative and postoperative polysomnography data. **Results:** There were totally 7 cases who underwent MMA procedure for OSA in our clinic. The mean age was 38.6 ± 8.1 years. Surgical success was achieved in all cases (100%). The mean preoperative and postoperative apnea–hypopnea indexes were 63.3 ± 35.2 and 7.5 ± 3.4, respectively ($P < 0.05$). The most common complication was inferior alveolar nerve deficit following bilateral sagittal split osteotomy. The facial numbness was temporary in 4 (57.1%), and permanent in one case (14.3%). **Conclusion:** Our surgical results in MMA is compatible with literature data. MMA is the choice of treatment in severe OSA in case of positive airway pressure therapy intolerance.

Keywords: *Apnea–hypopnea index, maxillomandibular advancement, obstructive sleep apnea, polysomnography, positive airway pressure*

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Introduction

Obstructive sleep apnea (OSA) is a common health problem affecting 9%–38% of the adult population.[1] The main symptoms are snoring, witnessed sleep apnea, and increased daytime sleepiness.[2] It is caused by repetitive, partial, or complete obstruction of the upper airway during sleep. If left untreated, it may result in major cardiovascular diseases such as, hypertension, stroke, myocardial infarction, and even sudden death during asleep.[3] Increased daytime sleepiness may be evaluated with Epworth sleepiness scale which is indicating the individuals with high risk of having OSA syndrome (OSAS).[4,5] However, the gold standard diagnosis is based on polysomnography (PSG) study performed in the sleep laboratory.[6] According to apnea–hypopnea index (AHI) or respiratory disturbance index revealed with PSG, OSA is classified to be mild (AHI between 5 and 15), moderate (AHI between 15 and 30), or severe (AHI >30).[7] In general, positive airway pressure (PAP) therapy is the standard treatment modality for OSA. It has been shown to significantly reduce AHI and daytime sleepiness.[8] However, patient adherence is a challenging issue as more than 50% of the cases are noncompliant with PAP treatment.[9] Lifestyle changes such as weight loss, oral appliances, and surgical interventions are other treatment options for OSA. There are several surgical procedures for the treatment of OSA such as septoplasty, tonsillectomy, uvulopalatopharyngoplasty (UPPP), laser-assisted uvuloplasty, radiofrequency of soft palate or tongue base, midline glossectomy, and tongue-base suspension which are all addressing different obstruction levels (nasal cavity, oral cavity, retropalatal, retrolingual regions, etc.). There are also surgical options addressing multilevel obstruction such as maxillomandibular

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advancement (MMA).[10] MMA enlarges both oropharyngeal and hypopharyngeal airway.[11] It includes midsagittal split mandibular osteotomies and Le Forte Type I osteotomy. It is known to be the most efficient surgical procedure for the treatment of OSA. Therefore, it is indicated for the treatment of moderate-to-severe OSA in case of patient intolerance to PAP treatment.[12] In this study, we aimed to present our clinical experience with MMA for the treatment of OSAS and to compare our results with literature data.

Materials and Methods

This study was conducted in Otorhinolaryngology Department of Gazi University Faculty of Medicine. Approval was obtained from the local ethics committee. The OSA patients who have undergone MMA procedure between 2007 and 2015 were retrospectively enrolled in the study. Seven patients with severe OSA (AHI >30) and noncompliant to PAP treatment were included for the study. Two patients with severe OSA who were also noncompliant to PAP treatment rejected the MMA operation due to possible undesired change on facial appearance. A detailed patient's chart review including preoperative and postoperative PSG findings were performed. The participants without available PSG reports were excluded from the study. Demographic data including body mass index (BMI) were recorded. Postoperative PSG study was performed 6 months after the surgery. Preoperative and postoperative PSG data including AHI scores, and oxygen saturation levels (SpO_2) were analyzed. Postoperative AHI lower than 20 or %50 in AHI from preoperative level was considered as a surgical success. Postoperative AHI score <5 was defined as a surgical cure.[12,13]

Preoperative evaluation-surgical procedure

All the patients passed through otorhinolaryngologic examination including Muller's maneuver. Lateral cephalometric analyses were performed at Faculty of Dentistry. Orthopantomogram and cephalometric examinations were carried out. The optimal advancements in mandible and maxilla were decided on cephalometry. The patients were informed about the change in their facial appearance after surgical procedure with cephalometric analysis. Maximal advancement while preserving pleasant facial appearance was planned, and the splints were designed accordingly. Informed consent was obtained from all participants. All the patients underwent a standardized surgical procedure, by the same surgeons, consisting of Le Fort I osteotomy and bilateral sagittal split osteotomies, under general anesthesia with nasotracheal intubation. Titanium miniplates and screws used for fixation. Maxillomandibular fixation (MMF) was performed at the end of the procedure. Additional procedures included; genioglossal advancement in two cases and distraction osteogenesis in one case with mandibular anomaly. The patients were discharged on the 3rd postoperative day. The MMF was kept in place for 2 weeks.

Statistical analysis

The statistical analysis was performed using SPSS version 20.0 (IBM Corp., Armonk, NY, USA) statistical software package. The descriptive statistics were presented as mean ± standard deviation. Continuous variables were tested by Kolmogorov–Smirnov Test, histograms, and P-P test for normality. Preoperative and postoperative PSG data were compared with Wilcoxon signed-rank test. In all the tests, $P < 0.05$ was considered to be statistically significant.

Results

In our retrospective analysis, we have identified 7 cases who had been performed MMA for OSA in our clinic. The mean age at presentation was 38.6 ± 8.1 years. Six cases (85.7%) were male and only one case (14.3%) was female. The mean preoperative BMI was 28.7 ± 4.3. Preoperative and postoperative PSG results for each patient are shown in Table 1. The mean preoperative and postoperative AHI were found to be 63.3 ± 35.2 and 7.5 ± 3.4, respectively ($P = 0.018$). The surgical success (%50 decrease in AHI or AHI lower than 20) was achieved in all cases (100%). Surgical cure was achieved in three cases (42.9%). The mean preoperative and postoperative lowest SpO_2 were found to be 70.4 ± 7.1 and 89.1 ± 2.9, respectively ($P = 0.018$). The mean MMA revealed 8.4 ± 3.1 for maxilla, 10.8 ± 2.3 mm for maxilla and mandibula, respectively, in this study. The preoperative and postoperative profile images of two participants are shown in Figure 1. Comparison of preoperative and postoperative cephalometry images are



Figure 1: Preoperative and postoperative profile images of two patients

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Table 1: Demographic findings and comparison of pre-postoperative polysomnography data

Patient number	Gender	BMI	Age	AHI		$LSpO_2$	
				Preoperative	Postoperative	Preoperative (%)	Postoperative (%)
1	Male	28.6	43	97.4	11.6	66	88
2	Male	38.0	33	127	12	61	85
3	Male	26.5	32	31.2	4.8	80	93
4	Male	29.3	48	44.2	3.7	74	91
5	Male	25.1	27	45.2	6.7	63	86
6	Male	27.3	40	47.1	4.5	74	91
7	Female	26.4	47	53	9	75	90
Mean	Male/female 6:1	28.7±4.3	38.6±8.1	63.3±35.2	7.5±3.4	70.4±7.1	89.1±2.9

AHI=Apnea-hypopnea index; $LSpO_2$=Lowest oxyhemoglobin saturation level; BMI=Body mass index

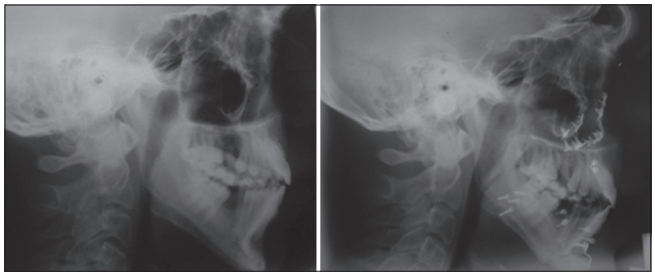


Figure 2: Preoperative and postoperative comparison with cephalometry

shown in Figure 2. The most common complication was facial paresthesia in the lower lib and chin due to inferior alveolar nerve damage during surgery. Facial numbness was unilateral and temporary in four cases (57.1%) but unilateral and permanent in one case (14.3%). Due to previous intubation failure information in the medical history, one of our patients was offered elective tracheostomy. One patient had repeat surgery for mandibular relapse. There was no case with worsening in facial appearance or malocclusion. No major complication was observed.

Discussion

OSA is a common disease which was first described about 40 years ago.[14] The prevalence may vary according to the criteria used for the diagnosis and the population studied.[1,15] If AHI ≥5 is considered for the OSA diagnosis, the prevalence ranges from 9% to 38% in the adult population.[1] While there is not still a full consensus on etiology, upper airway dimensions' insufficiency during sleep is among the most common accusations.

Unless treated, it may cause increased mortality and morbidity, particularly in severe cases because of susceptibility to cardiovascular diseases.[3] Based on the risk factors of the patients and physical examination findings, various treatment approaches may be considered for the therapy. Surgical treatment may be considered in case of upper airway obstruction due to tonsillar hypertrophy, septal deviation, etc.[16] In addition, bariatric surgery may be advised if morbid obesity is present.[17] However, morbid obesity is not so common in our country. In the study of Erem *et al*., morbid obesity prevalence was 0.2% among 1324 adult male participants.[18] In this study, the mean preoperative BMI revealed 28.7 ± 4.3 (range 25.1–38.0). There was no case with morbid obesity. Besides obesity, midface hypoplasia is the most common disorder in OSA rather than maxillofacial anomaly as shown in cephalometry studies.[19]

The initial approach for the OSAS cases without major obstruction in upper airway is to recommend PAP therapy. However, approximately 50% of the patients are noncompliant with PAP treatment at the end of 1st year.[9,20] In our clinical practice, we apply a variety of surgical treatments for these cases. Especially in cases with AHI above 30 and severe oxygen desaturation, information about MMA surgery is given. PAP is recommended for all patients as initial therapy, but if the patient is intolerant or unwilling to use a mask, she/he is referred to the maxillofacial surgery department of Dentistry Faculty for cephalometric analysis and to evaluate possible changes in facial appearance after MMA. In the study of Lye *et al*., maxillary advancement was found to be correlated with the reduction in AHI.[21] However, a maximum advancement of about 10 mm is recommended in the maxilla because further advancement (>10 mm) may result in unwanted facial appearance and dental problems.[22-24] Therefore, we carried out maximal advancement without causing undesired facial appearance. In our series, the mean advancement for maxilla and mandibula revealed 8.4 ± 3.1 and 10.8 ± 2.3 mm, respectively.

Three different meta-analyses performed for MMA in literature were reviewed. According to these meta-analysis studies, MMA is an effective and reliable surgical option in the treatment of OSA.[12,25,26] Holty and Guilleminault evaluated the efficiency of MMA operation for the treatment of OSA. They have reviewed 914 manuscripts in the literature. Twenty-seven papers including 627 adult cases were included in the study.

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Preoperative and postoperative AHI results revealed 63.9 ± 26.7 and 9.5 ± 10.7, respectively. Postoperative AHI results were significantly decreased ($P < 0.001$). In this study, the surgical success was defined as postoperative AHI lower than 20 or %50 decrease in AHI from preoperative level. Postoperative AHI score lesser than 5 was defined as surgical cure as well. The surgical success and cure rates were reported to be 86.0 ± 30.9% and 43.2 ± 11.7%, respectively.[12] Riley *et al*. reported a success rate of 98%.[27] Our results are also compatible with literature data. In our study group, surgical success was achieved in all cases (100%). However, the surgical cure was achieved in three cases (42.9%). The mean preoperative and postoperative AHI were found to be 63.3 ± 35.2 and 7.5 ± 3.4, respectively ($P < 0.05$).

According to the Stanford protocol, MMA is supposed to be a phase II operation in the treatment of OSA, meaning that it is preserved for an unsuccessful result after a phase I operation like UPPP.[28] However, it may also be carried out for the initial treatment of OSA in severe cases.[29] In our series, MMA was also the primary surgical treatment for all cases. Because in case of severe OSA, first, we recommend patient to use PAP therapy. If the patient is noncompliant to or refuses PAP treatment, then we recommend MMA.

There are some common complications associated with MMA including facial numbness, malocclusion, and worsening in facial appearance. Major complications such as avascular necrosis and cardiac arrest are reported to be 1%. However, minor complications such as mandibular relapse, facial paresthesia, and malocclusion are reported to be 3.1%.[24] The most common complication is inferior alveolar nerve damage in MMA.[30,31] There was one case with permanent unilateral numbness at lower face in our series (14.3%). This patient was reoperated for the mandibular relapse. Temporary facial numbness was observed in four cases (57.1%) There was no participant with the complaint of worsening in facial appearance or malocclusion. No major complication was encountered as well. The major limitations of our study are the limited sample size (Seven patients) and retrospective study design.

Conclusion

Our surgical results in MMA are compatible with the literature data. MMA is the treatment of choice in severe OSA in case of PAP therapy noncompliance.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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