Skeletal Stability of Patients Undergoing Maxillomandibular Advancement for Treatment of Obstructive Sleep Apnea

Sang Hwa Lee, DDS, PhD, [*] *Leonard B. Kaban, DMD, MD,* [†] *and Edward T. Lahey, DMD, MD* [‡]

Purpose: To determine the long-term stability of maxillomandibular advancement (MMA) in patients with obstructive sleep apnea (OSA).

Materials and Methods: This was a retrospective cohort study of patients who underwent MMA and genial tubercle advancement (GTA) for treatment of OSA. Patients were included if they *1)* were older than 19 years; *2)* had a confirmatory polysomnogram; *3)* underwent a Le Fort I osteotomy, bilateral sagittal split osteotomies, and GTA; *4)* had adequate radiographic documentation; and *5)* at least 11 months of follow-up. Exclusion criteria included previous orthognathic or other maxillofacial surgery. Predictor variables were the presence of OSA treated by MMA, pre- and postoperative orthodontia or no orthodontia, length of follow-up, and magnitude of advancement. The outcome variable was the stability of MMA judged by clinical examination and cephalometric measurements. Standardized lateral cephalometric measurements were performed preoperatively (T0), immediately postoperatively (T1), and at the latest follow-up beyond 11 months (T2). Differences in cephalometric measurements were calculated between time points (T0 to T1 and T1 to T2) for the overall group and for patients who had orthodontia (group 1) and those who did not (group 2). A correlation analysis using length of follow-up and magnitude of advancement as predictor variables of stability was completed. For all analyses, a *P* value less than .05 was considered statistically significant.

Results: During the 9-year study period, 120 patients with OSA were evaluated and 112 had operative treatment; 25 patients specifically had MMA and GTA, met the inclusion criteria, and formed the study sample. The mean maxillary and mandibular advancements (T1 vs T0) were 9.48 mm (range, 1.6 to 15.2 mm) and 10.85 mm (range, 6.3 to 15.8 mm), respectively. From T1 to T2, no occlusal changes occurred. Changes in the subgroup analyses included a decrease in the angle formed by the sella, nasion, and A point (SNA) and the angle formed by the nasion and A and B points (ANB) and an increase in the angle formed by the mandibular plane (gnathion and gonion) to a line from the sella to the nasion in group 1 and a decrease in ANB in group 2. The only statistical mean difference in cephalometric measurements between groups was in the distance between the condylion and the gnathion. There was no correlation between length of follow-up (mean, 27.84 months) and changes in cephalometric measurements.

Conclusion: Results of this study indicate that although there were changes in the SNA and ANB from T1 to T2 suggesting maxillary relapse, the mean difference was no greater than 1° and no patients developed

[*]Former Visiting Research Fellow, Department of Oral and Maxillofacial Surgery, Massachusetts General Hospital and Harvard School of Dental Medicine, Boston, MA; Currently Associate Professor, Department of Oral and Maxillofacial Surgery, Yeouido St Mary's Hospital, The Catholic University of Korea, Seoul, Korea.

[†]Walter C. Guralnick Professor and Chairman, Department of Oral and Maxillofacial Surgery, Massachusetts General Hospital and Harvard School of Dental Medicine, Boston, MA.

[‡]Assistant in Oral and Maxillofacial Surgery and Instructor, Department of Oral and Maxillofacial Surgery, Massachusetts General Hospital and Harvard School of Dental Medicine, Boston, MA.

This work was conducted with support from the Harvard Catalyst and the Harvard Clinical and Translational Science Center (National Center for Research Resources and National Center for Advancing Translational Sciences, National Institutes of Health Award 1UL1 TR001102-01) and financial contributions from Harvard University and its affiliated academic health care centers and the Massachusetts General Hospital Department of Oral and Maxillofacial Surgery Education and Research Fund.

Conflict of Interest Disclosures: None of the authors reported any disclosures.

Address correspondence and reprint requests to Dr Lahey: Department of Oral and Maxillofacial Surgery, Massachusetts General Hospital, Warren Building, 55 Fruit Street, Suite 1201, Boston, MA 02114; e-mail: elahey@mgh.harvard.edu

Received July 14 2014

Accepted October 17 2014

0278-2391/14/01617-6

http://dx.doi.org/10.1016/j.joms.2014.10.018

a malocclusion; therefore, the changes were considered clinically minor. Advancement of the maxillomandibular complex by 10 mm for treatment of OSA remains stable at a mean follow-up period longer than 2 years and preoperative orthodontic treatment does not appear to influence skeletal stability.

J Oral Maxillofac Surg 73:694-700, 2015

Obstructive sleep apnea (OSA) is characterized by repeated narrowing or collapse of the upper airway during sleep.[1,2] It results in a continuum of changes in upper airway resistance, lower blood oxygen levels, fragmentation of sleep, snoring, daytime fatigue, and hypersomnia, which often lead to occupational disability and behavioral changes. Furthermore, there are clear correlations between OSA and long-term cardiovascular and pulmonary complications.[3]

The gold standard first-line treatment for OSA is continuous positive airway pressure, which pneumatically stents open the upper airway, preventing collapse during sleep. If patients can wear the mask effectively and tolerate the therapy for at least 6 hours of a sleep episode, there is high-level evidence for its efficacy in preventing airway collapse and relieving symptoms. However, more than 50% of patients are intolerant and reject the therapy within the first few months after initiation.[4,5]

Other treatments for OSA aimed at enlarging the upper airway while decreasing airway collapsibility include mandibular positioning devices and surgical reduction of the pharyngeal soft tissues.[6,7] Maxillomandibular advancement (MMA) surgery, often in conjunction with genial tubercle advancement (GTA), has been shown to be an effective surgical alternative for the treatment of OSA. Although there is no direct manipulation of pharyngeal tissue, MMA is believed to relieve OSA because the skeletal movements favorably alter upper airway shape.[7] The effectiveness of MMA for the treatment of OSA has been confirmed in short- and long-term follow-up studies using objective data (polysomnograms) and subjective data (patient questionnaires).[8-10] The evaluation of the skeletal stability of MMA is important because the amount of skeletal advancement (and therefore its stability) has been considered an important predictor of success in the surgical treatment of OSA.[9,11-15]

Maxillofacial surgical procedures used for MMA are the same as those used to correct malocclusions and facial esthetics in patients with dentofacial deformities (DFDs). Although the operations are technically the same, there are considerable differences between OSA and DFD patient cohorts. Patients with OSA are generally older and have more medical comorbidities than those with DFD and their occlusions might be normal. MMA for OSA usually entails moving the facial skeleton forward to a cephalometrically "telegnathic" position, whereas DFD treatment is aimed at positioning the facial skeleton to a cephalometric or esthetic "normal" position. The magnitude of skeletal movements is generally greater in the treatment of OSA than of DFD. A primary goal of orthognathic surgery for DFD is to correct the accompanying malocclusion. In patients with OSA, the occlusion often is not altered by the operation. The long-term stability of skeletal movements for the treatment of DFD has been studied; however, there are few publications evaluating the skeletal stability of MMA for OSA.[9,16-18] In addition, there are even fewer studies analyzing the effect on skeletal stability, if any, of orthodontic correction of dental occlusion in conjunction with MMA.

The objective of this study was to assess, by clinical and cephalometric analyses, the long-term skeletal and occlusal stability of MMA for the treatment of OSA. The authors hypothesized that MMA of the magnitude usually carried out for OSA would result in a skeletally stable result.

Materials and Methods

PATIENTS

This was a retrospective cohort study of all adult patients with OSA who underwent MMA in the Department of Oral and Maxillofacial Surgery at Massachusetts General Hospital (Boston, MA) from 2003 to 2012. Inclusion criteria were *1)* diagnosis of OSA by polysomnogram, *2)* MMA having been completed by Le Fort I and bilateral mandibular sagittal split osteotomies, *3)* adequate radiographic and clinical documentation, and *4)* postsurgical follow-up of at least 11 months. Exclusion criteria were *1)* previous orthognathic surgery and *2)* other previous maxillofacial surgery. Predictor variables were the presence of OSA treated by MMA, pre- and postoperative orthodontia or no orthodontia, length of follow-up, and magnitude of advancement. The outcome variable was the stability of MMA, defined as no patient-reported or clinically observed changes in occlusion and no major changes in cephalometric measurements between immediate postoperative images and long-term images. Patients were divided into 2 groups: group 1 received preoperative and postoperative orthodontia and group 2 received no orthodontic treatment. This study was approved by the Partners Institutional Review Board (protocol number 2013P001140).