Pharyngeal airway evaluation after isolated mandibular setback surgery using cone-beam computed tomography

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Introduction: In this study, we investigated volumetric and dimensional changes to the pharyngeal airway space after isolated mandibular setback surgery for patients with Class III skeletal dysplasia. **Methods:** Records of 28 patients who had undergone combined orthodontic and mandibular setback surgery were obtained. The sample comprised 17 men and 11 women. Their mean age was 23.88 ± 6.57 years (range, 18-52 years). Cone-beam computed tomography scans were obtained at 3 time points: before surgery, average of 6 months after surgery, and average of 1 year after surgery. Oropharyngeal, hypopharyngeal, and total volumes were calculated. The lateral surface and anteroposterior dimensions at the minimal axial areas for oropharyngeal and hypopharyngeal volumes and mean mandibular setback were determined. **Results:** The mean mandibular setback was 9.93 ± 5.26 mm. Repeated measures analysis of variance determined an overall significant decrease between the means for 6 months and up to 1 year after surgery for oropharyngeal and hypopharyngeal volumes, anteroposterior at oropharyngeal, lateral surface at oropharyngeal, and anteroposterior at hypopharyngeal. No strong correlation between mandibular setback surgery and pharyngeal airway volumes or dimensions was determined. **Conclusions:** After mandibular setback surgery, pharyngeal airway volume, and transverse and anteroposterior dimensions were decreased. Patients undergoing mandibular setback surgery should be evaluated for obstructive sleep apnea and the proposed treatment plan modified according to the risk for potential airway compromise. (Am J Orthod Dentofacial Orthop 2018;153:46-53)

In patients with severe skeletal Class III dysplasia, combined orthodontic-orthognathic surgical treatment provides an esthetic and functional solution. Isolated mandibular setback surgery is a treatment option for the correction of this dysplasia. An important aspect of this surgical correction is that it causes changes in the position of the hyoid bone and the base of tongue.[1-4] The posterior shift of the tongue base creates an increase in contact length between the soft palate and the tongue base and can decrease the pharyngeal airway space.[1,4-6] The resultant changes in hard and soft tissues after mandibular setback surgery have been shown to produce a shift in oropharyngeal characteristics to a morphology associated with sleep-disordered breathing, typical of obstructive sleep apnea (OSA).[7]

OSA is characterized by repeated increases in resistance to airflow in the upper airway, causing obstruction.[8] It is also characterized by the periodic partial or complete collapse of the upper airway that results in episodes of hypopnea (diminished airflow of at least 30%, lasting at least 10 seconds) or apnea (absent airflow).[8-10] The collapse of soft tissues in the upper airway, including the retropalatal and retroglossal regions of the oropharynx, play a role in the etiology of OSA.[11] Epidemiologic estimates of OSA prevalence are about 4% for men and 2% for women in the age group of 30 to 60 years in the United States when considering subjective daytime sleepiness.[12-16] Approximately 1 in 5 adults has at least mild OSA, and 1 in 15 adults has OSA of moderate or worse severity.[12,17,18]

Initial research performed to evaluate the effect of mandibular setback surgeries on the pharyngeal airway space have been evaluated with lateral cephalograms.[7,19-24] The limitations of a lateral cephalogram are that it is a static, 2-dimensional image that does not adequately represent the 3-dimensional volumetric

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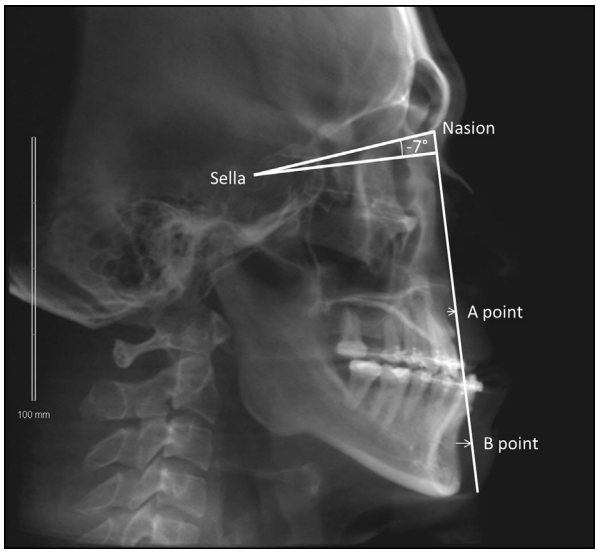

Fig 1. Lateral cephalogram demonstrating measurement of surgical movement.

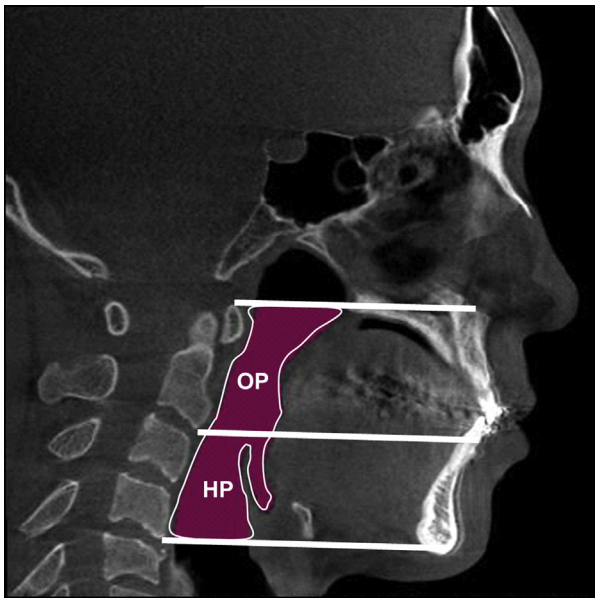

Fig 2. Segmentation of OP and HP volumes.

data.[25] Recently, cone-beam computed tomography (CBCT) has been used to evaluate the airway changes 3 dimensionally.[26] The majority of CBCT studies examining pharyngeal airway volume changes have patients undergoing a combination of maxillary advancement and mandibular setback surgery.[27-30] Thus, there is limited evidence in the literature describing the effect of isolated mandibular setback surgeries on pharyngeal airway space using CBCT. Further research may elucidate whether a setback alone contributes to a negative impact on the airway and possibly exacerbate OSA.

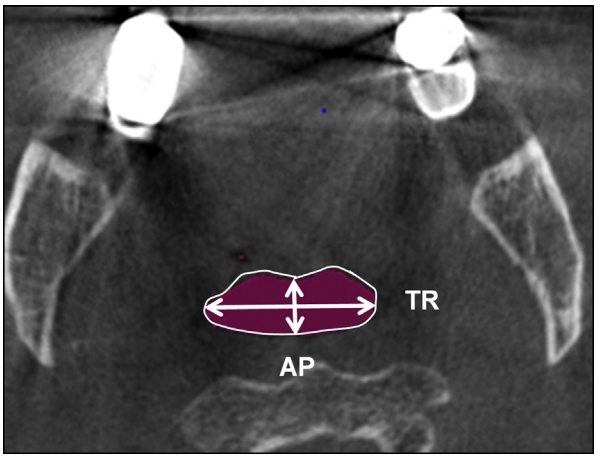

Fig 3. Segmentation of TR and AP.

The aims of this study were to evaluate volumetric and dimensional changes in the pharyngeal airway space for patients who have undergone isolated mandibular setback surgery with CBCT, and also to determine whether a relationship exists between mandibular setback surgery and pharyngeal airway volumes or dimensions.

MATERIAL AND METHODS

For this study, the records of 28 patients who had undergone combined orthodontic and isolated mandibular setback surgery to correct Class III skeletal dysplasia were obtained. The sample included 17 men and 11 women. Their mean age was 23.88 ± 6.57 years, with a range of 18 to 52 years. The sample was retrieved from the Department of Orthodontics at Pusan National University Hospital, Busan, South Korea. The setback surgery consisted of sagittal split ramus osteotomy of the mandible with rigid fixation. CBCT scans were obtained at 3 time points: T1 (before surgery), T2 (an average of 6 months after surgery), and T3 (an average of 1 year after surgery). The inclusion criteria for this study were adults with Class III skeletal deformities who had undergone mandibular setback surgery and orthodontic treatment. The exclusion criteria were severe facial asymmetry or syndrome, and symptoms of temporomandibular disorders or respiratory disease.

The presurgical and postsurgical apnea-hyponea index values and the body mass index values of the subjects were not available for this study.