Shimane J. Med. Sci., Vol.33 pp.93-98, 2017

Genioglossus Advancement Accompanied by Mandibular Setback and Maxillary Advancement Surgery in Severely Obese Patient

Taichi IDE, Takahiro KANNO, Masaaki KARINO, Aya YOSHINO, Joji SEKINE

Department of Oral and Maxillofacial Surgery, Shimane University Faculty of Medicine, Izumo, 693-8501, Japan

(Received January 19, 2017; Accepted January 31, 2017)

Genioglossus advancement (GA) is applied alone or mostly in combination with oropharyngeal operations as a part of multi-level surgery, or with definitive maxillofacial skeletal operation of maxillomandibular advancement with high success and cure rates for the treatment of obstructive sleep apnea syndrome patients by relieving airway obstruction at the hypopharyngeal level. Here we report the feasible application of this GA to the mandibular setback orthognathic surgery with diagnosed mandibular prongathism with anterior open bite in a severely obese patient in consideration of postoperative respiratory risk of the airway obstruction, followed by the successful management of perioperative and postoperative phase after bi-maxillary orthognathic surgery.

Key words: genioglossus advancement, obese patient, piezoelectric device

INTRODUCTION

A review of the literature indicates that maxillary and mandibular advancement (MMA) is highly successful in the treatment of patients with obstructive sleep apnea syndrome (OSAS) [1]. MMA may be performed as a standalone procedure or as part of a staged treatment, with the latter providing the highest success rates [1]. The genioglossus advancement (GA) is a proven technique for the treatment of mild to moderate OSAS, by relieving airway obstruction at the hypopharyngeal level [1-4]. The reason for selecting GA as the surgical treatment for OSAS is that it stabilizes the upper airway and prevents prolapse of the tongue base through forward movement of the genial tubercle and genioglossus muscle [1, 2]. Several techniques to improve the posterior airway space have been reported. Riley et al [5] first described inferior sagittal osteotomy in 1984. This allows for advancement of the suprahyoid muscles, including the genioglossus, and stabilization at a far more anterior position enabling airway enlargement. The initial case report described a procedure that was essentially standard horizontal genioplasty advancement, and the same group also modified their technique to reduce the risk of mandibular fracture [3, 6]. The current literature contains many reports about the results of GA techniques for the treatment of OSAS.

Mandibular setback surgery in orthognathic surgery, on the other hand, reduces the oropharyngeal airway space, inducing sleep-disordered breathing, typified by OSAS [7, 8]. Several studies reported cases where mandibular setback surgery resulted in a reduction of the pharyngeal airway space and OSAS, and also identified increased body weight and neck circumference as OSAS predictors. An updated meta-analysis described how mandibular setback surgery effects a significant decrease in airway volume [9]. Obstruction that causes episodes of apnea results from collapse of the pharyngeal airway and usually occurs at the oropharynx or velopharynx. Genetic and environmental factors in the development of obstructive sleep apnea have been linked to obesity, skeletal conditions (e.g., a short mandibular body or mandibular retreat), large tongue or uvula, shape of the airway, age, and ethnicity [7, 8]. To prevent obstructive sleep apnea following mandibular

Corresponding author: Joji Sekine, D.D.S., Ph.D., FIBCSOMS
Department of Oral and Maxillofacial Surgery, Shimane University Faculty of Medicine, 89-1 Enya-cho, Izumo, Shimane 693-8501, Japan
Tel: +81-853-20-2301
Fax: +81-853-20-2299
E-mail: georges@med.shimane-u.ac.jp

setback, it is important to evaluate the risks of, and design a plan for, orthognathic surgery. Accordingly, the perioperative management of severely obese patients is more complex and needs to be taken into consideration because of the high risk of airway obstruction.

Here we present the first report of the simultaneous application of GA, using a piezoelectric device, and mandibular setback with maxillary advancement surgery in a severely obese patient in order to prevent postoperative respiratory risk of airway obstruction. Management of the peri- and postoperative phases of bimaxillary orthognathic surgery is also discussed.

CASE

A 33-year-old Japanese woman was referred to our hospital in February 2015. The diagnosis was skeletal anterior open bite induced by high mandibular plane angles. She was also severely obese with a BMI of 40.1. Presurgical orthodontic treatment was administered for 9 months, and we then planned Le Fort I osteotomy for posterior impaction (3 mm) at the first molar with clockwise rotation together with mandibular setback (6 mm) at the anterior ramus via bilateral sagittal split osteotomy. Due to her severe obesity, we carefully considered airway obstruction following mandibular setback in the postoperative management. In addition to the 2-jaw orthognathic surgery, we planned to apply GA to reduce the perioperative and postoperative risk of airway obstruction by additional mandibular osteotomy at the symphysis.

The surgical procedure consisted of a conventional Le Fort I osteotomy with down-fracture and bilateral sagittal splitting ramus osteotomy, which were performed following the standard methods prior to GA surgery under general anesthesia. After intermaxillary fixation was secured, a local anesthetic with a vasoconstrictor was infiltrated into the submucosal tissue of the symphysis. An incision was made through the oral vestibular mucosa, and the periosteum was reflected fully around the symphysis down to the inferior border. The mandibular root apices of the incisors and canines were noted, and the osteotomy site was marked as we had simulated in detail preoperatively. First, the labial cortical bone osteotomy was performed using a piezoelectric device (Fig. 1), and then the outer cortex was removed. Subsequently, the remaining lingual cortex bone osteotomy was performed with a piezoelectric device including the genial tubercles and the entire attachment of the genioglossus muscle. This was followed by insertion of the skeletal anchor screw into the lingual cortex bone to allow for forward advancement of the segment with the genioglossal muscle with manual control.

Once all the osteotomies were verified and the bone segment was freed, the labial cortex bone segment with the genioglossal muscle was pulled forward, and the location was changed by rolling one-quarter clockwise (Fig. 2). Adequate soft tissue laxity was a critical factor in ensuring free advancement, because overt tension in this area can result in muscular detachment from the lingual cortex. For stabilization of the segment, the inner cortex was rigidly fixed at its lateral ends to the basal bone with a bioactive absorbable screw (OSTEOTRANS-MX [Super Fixsorb-MX® in Japan]; Takiron Co. Ltd., Japan).

After the operation, the patient was well managed with intubation and was safely extubated on postoperative day (POD) 1. Following an uneventful postoperative course, the patient was discharged on POD 7. A lateral cephalogram and three-dimensional (3-D) CT scans confirmed enlargement of the upper airway after surgery compared with before surgery (Figs. 3 and 4).

DISCUSSION

Several reports have suggested that mandibular setback surgery might induce disordered breathing, and the procedure can be further complicated by the risk factors for airway management of obesity and a large amount of mandibular setback [7, 8]. In a previous study, positive correlations between BMI and oximetry indices were found in patients who underwent mandibular setback surgery. Therefore, obese patients who have a large amount of mandibular setback are likely to be at risk for airway obstruction postoperatively. Accordingly, careful postoperative monitoring is recommended for obese

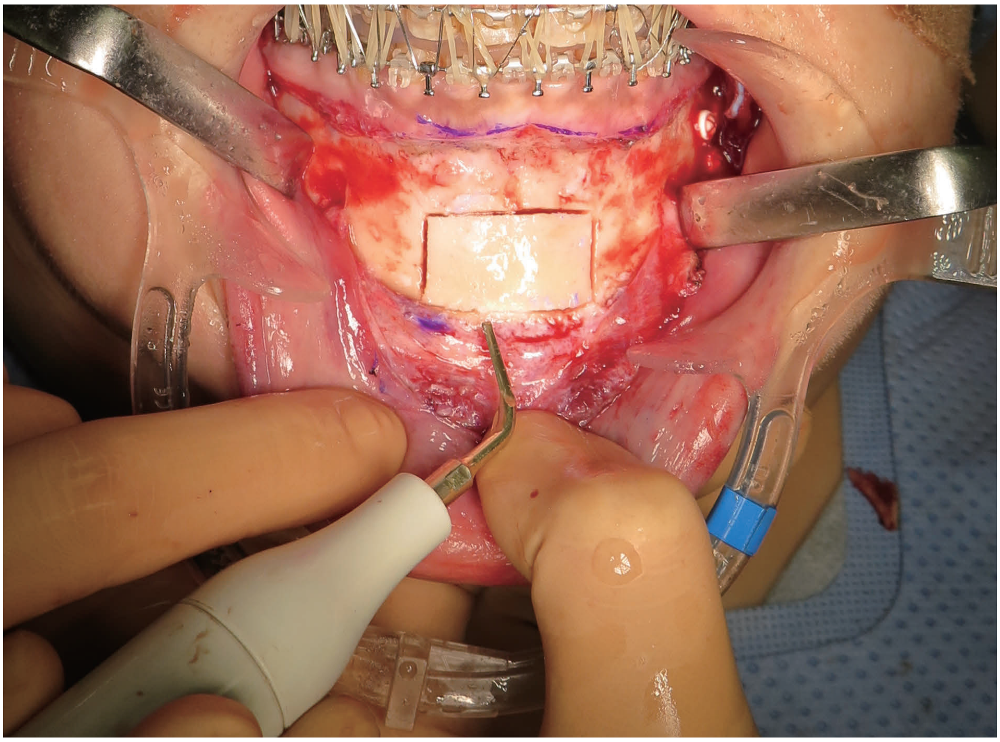

Fig. 1. Osteotomy using a piezo electric device of the labial cortical bone.

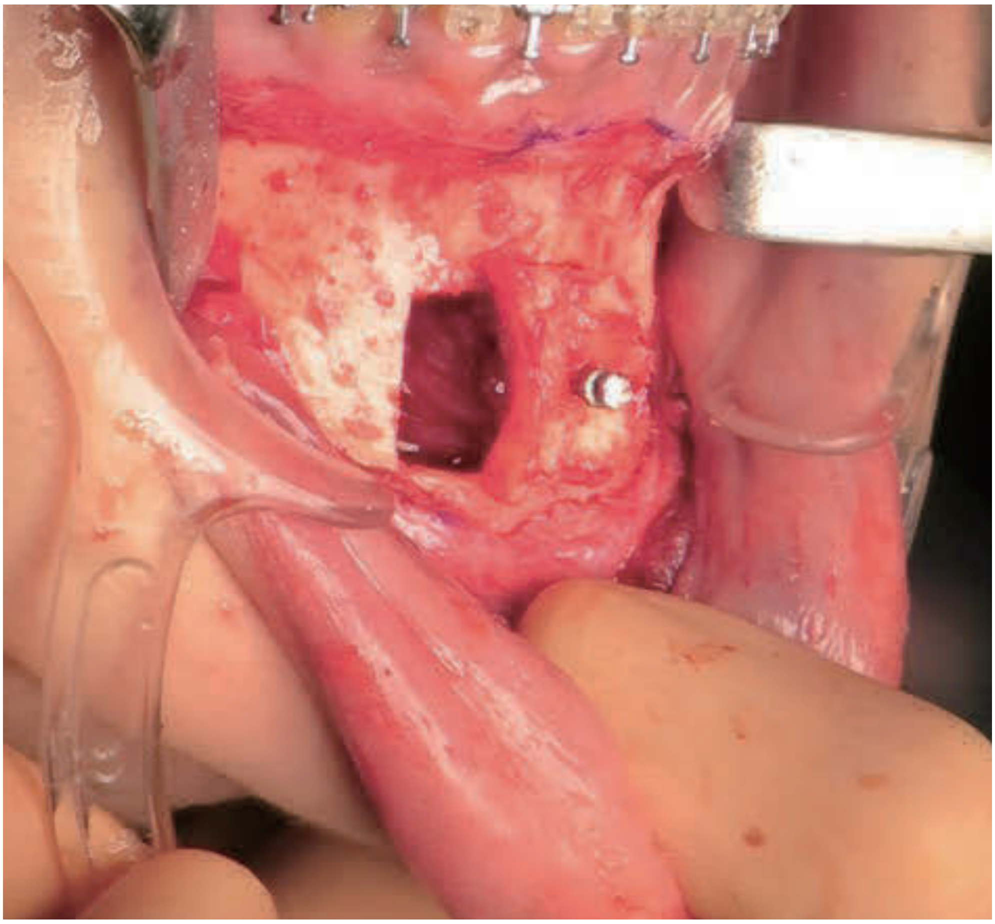

Fig. 2. Stabilization of the lingual cortex bone segment with the genioglossus muscle.

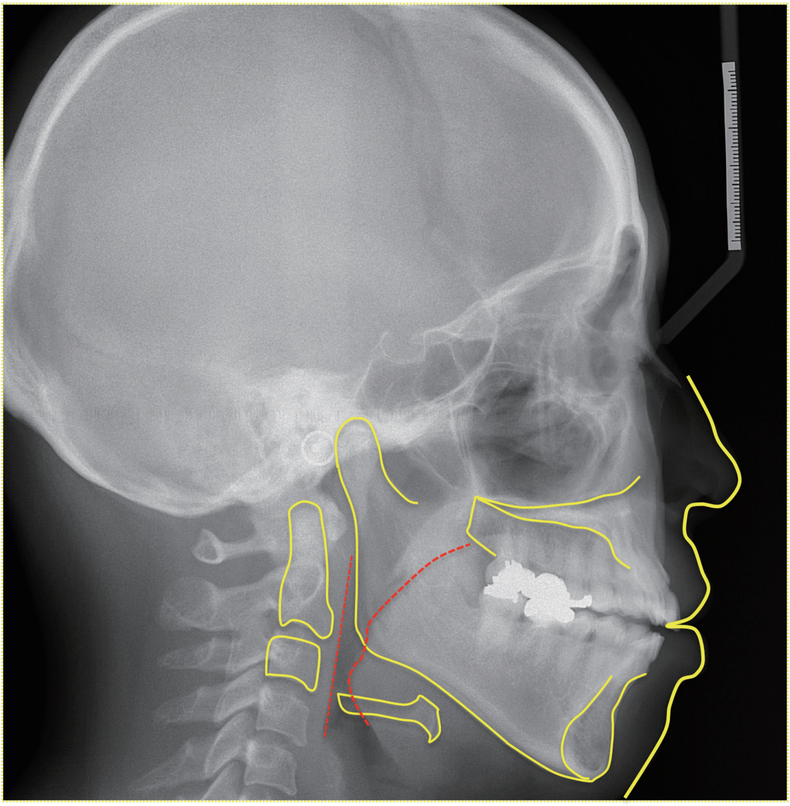

Fig. 3. Preoperative airway analysis using lateral cephalometric radiograph.

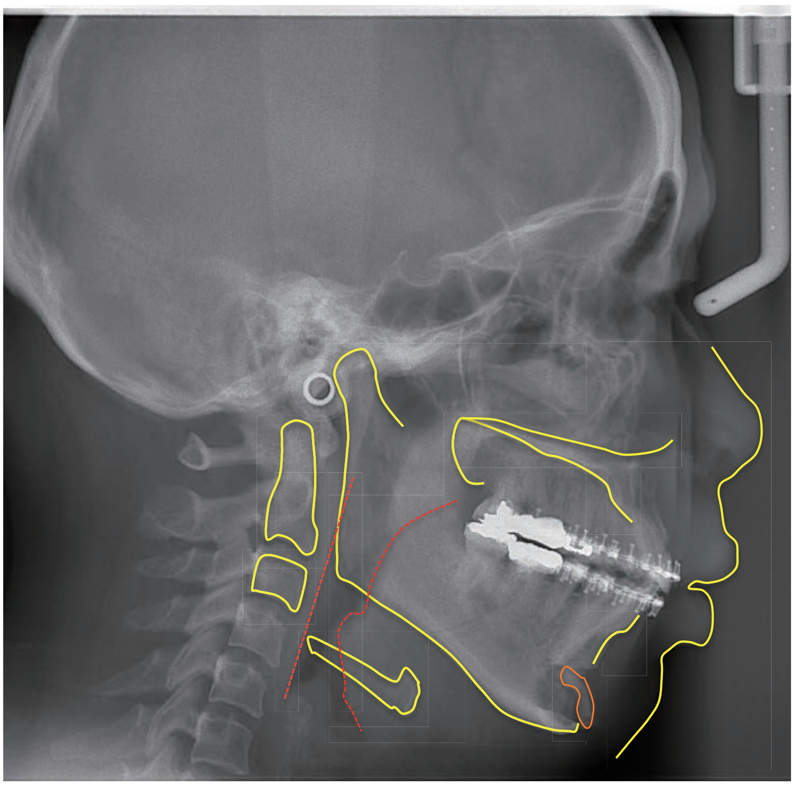

Fig. 4. Airway analysis using lateral cephalometric radiograph on postoperative day 3.

patients.

In addition, several techniques to improve the posterior airway space have been described. GA is generally applied in combination with oropharyngeal operations as a part of multi-level surgery for OSAS [2]. The American Academy of Sleep Medicine assessed the success rate of all surgical modifications of the upper airway and noted that genioglossus advancement with or without hyoid myotomy seemed to be the most beneficial method for widening the retrolingual space [3]. Several osteotomy designs have been used to advance the genioglossus musculature, including standard genioplasty, inferior sagittal osteotomy, circular genioplasty, and mortised genioplasty [3].

In our technique, we modified the standard method of osteotomy by removing the outer bone cortex and marrow with a piezoelectric device. This device has proven effective for osteotomy and makes the cutting of hard tissue possible through "selective cutting" without inducing necrosis from overheating as a result of friction and without damaging soft tissue [10]. The Piezoelectric device can decrease the risk of bleeding, thereby providing perfect depth control during osteotomy, and the absence of soft tissue damage considerably limits the risks of oral floor lesions [9]. We also applied a bioactive absorbable screw for the fixation of the bone segment. The absorbable implants did not require removal and did not produce artifacts on postoperative CT scans or 3-D CT images, permitting excellent analysis of postoperative outcome.

Here we have reported the feasibility of GA using a piezoelectric device together with mandibular setback and maxillary advancement surgery via sagittal splitting ramus osteotomy in a severely obese patient with skeletal anterior open bite and a high risk of postoperative airway obstruction. GA may be a useful adjunct surgical procedure for postoperative airway management of mandibular setback orthognathic surgery in severely obese patients.

ETHICAL APPROVAL

Not required.

CONFLICTS OF INTEREST

None.

ANKNOWLEDGEMENTS

None.

REFERENCES

1) Schendel S, Powell N, Jacobson R. Maxillary, mandibular, and chin advancement: treatment planning based on airway anatomy in obstructive sleep apnea. *J Oral Maxillofac Surg* 2011;69:663-6.

2) Kuscu O, Süslü AE, Özer S, Günaydın RÖ, Öğretmenoğlu O, Önerci M. Sole effect of genioglossus advancement on apnea hypopnea index of patients with obstructive sleep apnea. *Acta Otolaryngol* 2015;135:835-9.

3) Lee NR, Madani M. Genioglossus muscle advancement techniques for obstructive sleep apnea. *Atlas Oral Maxillofac Surg Clin North Am* 2007;15:377-84.

4) Demian NM, Alford J, Takashima M. An alternative technique for genioglossus muscle advancement in phase I surgery in the treatment of obstructive sleep apnea. *J Oral Maxillofac Surg* 2009;67:2315-8.

5) Riley R, Guilleminault C, Powell N, Derman S. Mandibular osteotomy and hyoid bone advancement for obstructive sleep apnea. *Sleep* 1984;7:79-82.

6) García Vega JR, de la Plata MM, Galindo N, Navarro M, Díez D, Láncara F. Genioglossus muscle advancement: a modification of the conventional technique. *J Craniomaxillofac Surg* 2014;42:239-44.

7) Al-Moraissi EA, Al-Magaleh SM, Iskandar RA, Al-Hendi EA. Impact on the pharyngeal airway space of different orthognathic procedures for the prognathic mandible. *Int J Oral Maxillofac Surg* 2015;44:1110-8.

8) Uesugi T, Kobayashi T, Hasebe D, Tanaka R, Ike M, Saito C. Effects of orthognathic surgery on pharyngeal airway and respiratory function during sleep in patients with mandibular prognathism. *Int*

J Oral Maxillofac Surg 2014;43:1082-90.

9）Christovam IO, Lisboa CO, Ferreira DM, Cury-Saramago AA, Mattos CT. Upper airway dimensions in patients undergoing orthognathic surgery: a systematic review and meta-analysis. *Int J Oral Maxillofac Surg* 2016;45:460-71.

10）Seshan H, Konuganti K, Zope S. Piezosurgery in periodontology and oral implantology. *J Indian Soc Periodontol* 2009;13:155-6.